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Kung et al.

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(52) **U.S. Cl.** **370/352**; 370/261; 370/392; 379/205.01; 379/207.13

(58) **Field of Search** 370/259–261, 370/401, 352, 389, 392, 395.52; 379/157, 158, 205.01, 207.02, 207.07, 201.08, 201.1, 207.13, 207.15, 207.16, 211.02, 90.01, 93.35

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Primary Examiner—Afsar Qureshi

(57) **ABSTRACT**

A method of alerting a user of a variable bit rate communication between a first terminal and a distant terminal over alternative networks including a circuit switched network and a packet network permits the user the opportunity to change alerting preferences from a remote location or locally and to predetermine instructions for a calling party. A method of alerting a broadband user at a first terminal of an incoming multimedia call from a particular calling party comprises the steps of receiving input data at a broadband gateway of user preferences of calling parties, calling party locations, and terminal configuration data for a terminal normally utilized by the user, alerting a called user by utilizing a user-defined alerting scheme, the scheme including identifying the multimedia call as one specifically intended for the user among a plurality of different users and identifying one of the identity or the location of the calling party, comparing the identity or location with said user preferences and alerting the calling party of the priority of the call, the priority of the call including an indication of whether the called party has left instructions for the calling party. In accordance with a further embodiment, a method of alerting a broadband user at a first terminal of an incoming multimedia call from a particular calling party comprises the steps of receiving input data at a broadband gateway of user preferences of calling parties, calling party locations, and terminal configuration data for a terminal normally utilized by the user, comparing the user preferences with data describing the incoming multimedia call, and, if the terminal normally utilized by the user is not appropriate for the call, alerting the called user to one of moving to another terminal or arranging to equip said terminal so that the terminal is appropriate for the call.

2 Claims, 9 Drawing Sheets

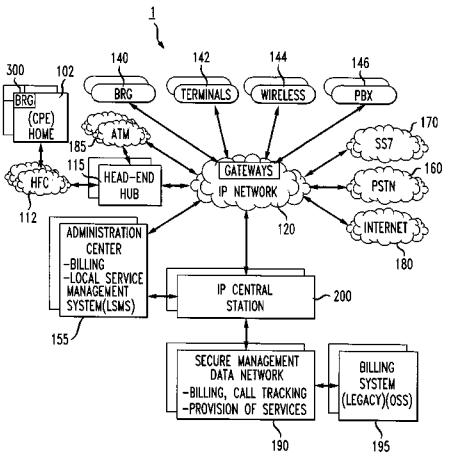

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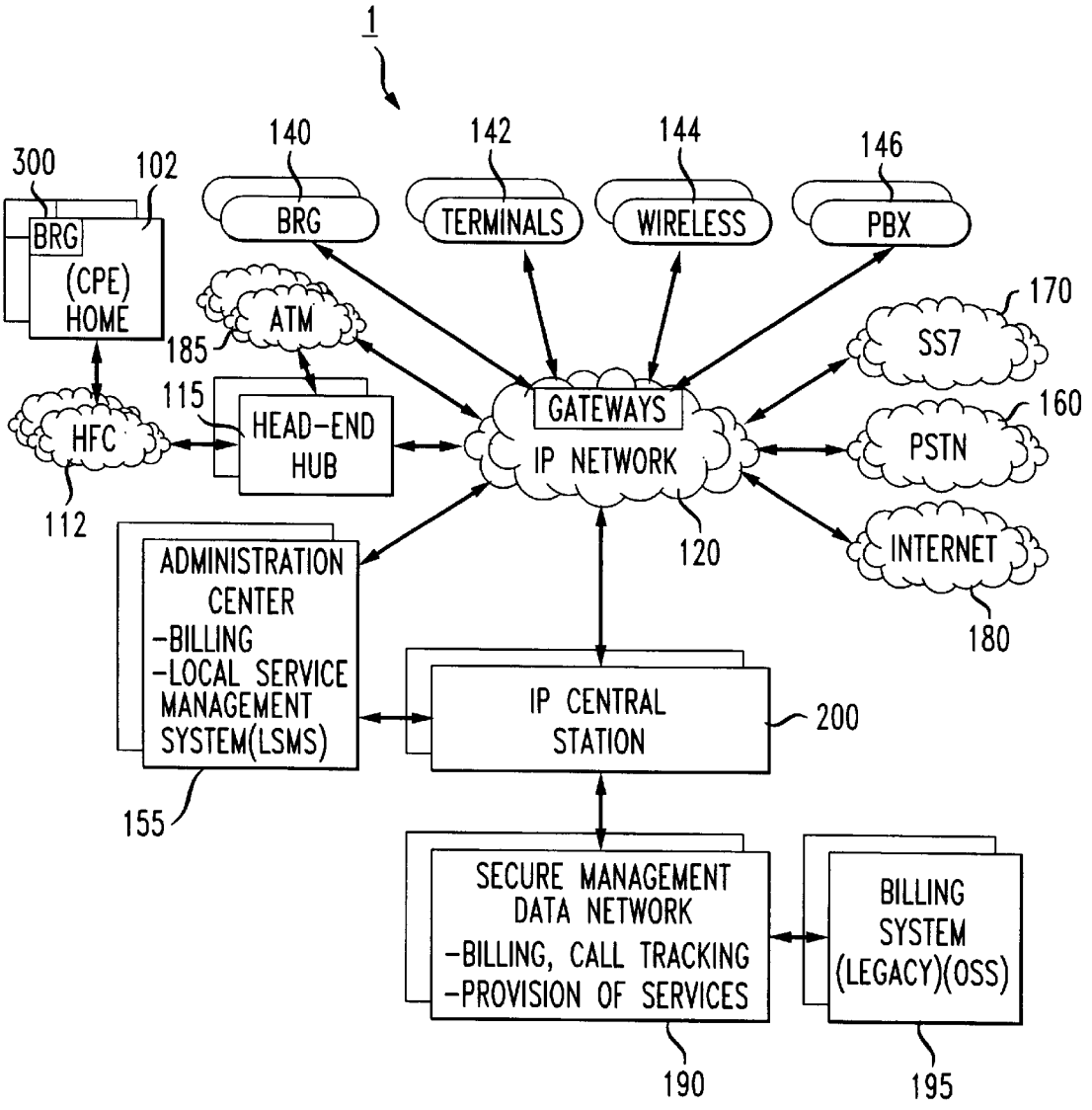
FIG. 1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BRG
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HOME
ATM
185
170
SS7
115
HEAD-END
HUB
GATEWAYS
IP NETWORK
160
PSTN
HFC
112
120
INTERNET
180
ADMINISTRATION
CENTER
-BILLING
-LOCAL SERVICE
MANAGEMENT
SYSTEM(LSMS)
IP CENTRAL
STATION
200
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SECURE MANAGEMENT
DATA NETWORK
-BILLING, CALL TRACKING
-PROVISION OF SERVICES
BILLING
SYSTEM
(LEGACY)(OSS)
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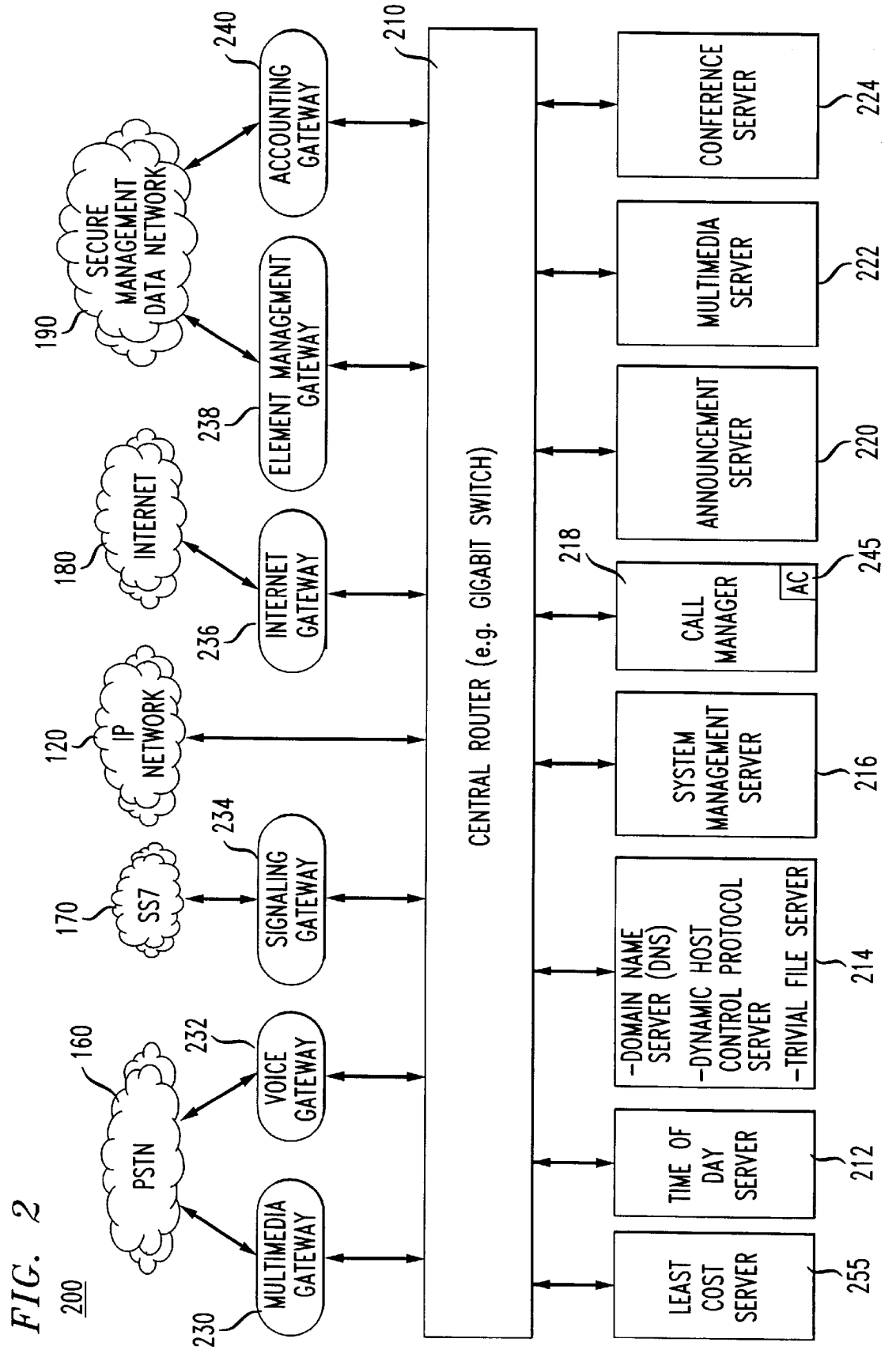
195

FIG. 2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CENTRAL ROUTER (e.g. GIGABIT SWITCH)
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IP NETWORK
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SS7
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INTERNET
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SECURE MANAGEMENT DATA NETWORK
190
MULTIMEDIA GATEWAY
230
VOICE GATEWAY
232
SIGNALING GATEWAY
234
INTERNET GATEWAY
236
ELEMENT MANAGEMENT GATEWAY
238
ACCOUNTING GATEWAY
240
LEAST COST SERVER
255
TIME OF DAY SERVER
212
-DOMAIN NAME SERVER (DNS)
-DYNAMIC HOST CONTROL PROTOCOL SERVER
-TRIVIAL FILE SERVER
214
SYSTEM MANAGEMENT SERVER
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CALL MANAGER
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AC
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ANNOUNCEMENT SERVER
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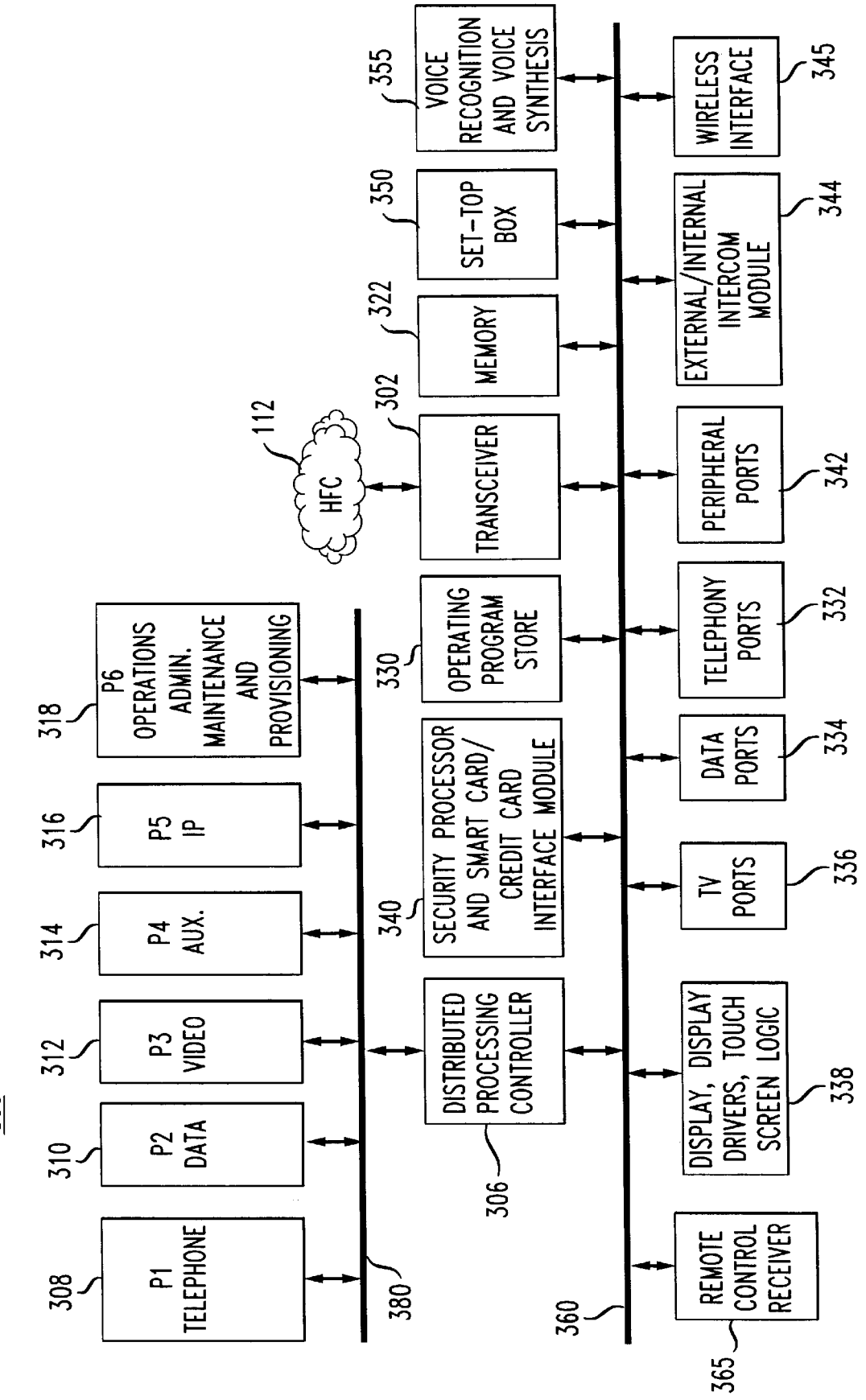
MULTIMEDIA SERVER
222
CONFERENCE SERVER
224

FIG. 3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P2 DATA
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P3 VIDEO
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P4 AUX.
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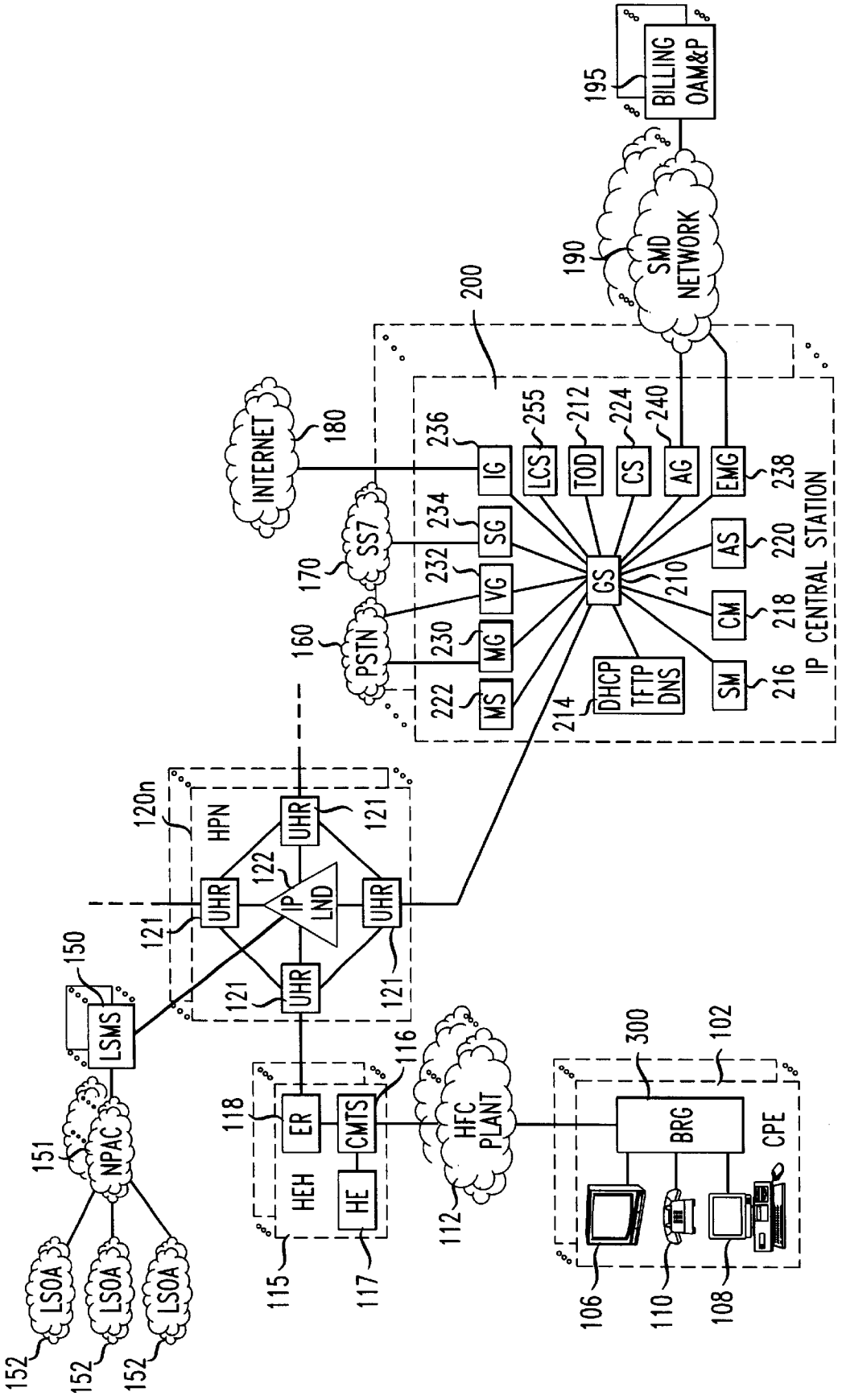
P5 IP
318
P6 OPERATIONS ADMIN. MAINTENANCE AND PROVISIONING
380
306
DISTRIBUTED PROCESSING CONTROLLER
340
SECURITY PROCESSOR AND SMART CARD/ CREDIT CARD INTERFACE MODULE
330
OPERATING PROGRAM STORE
112
HFC
302
TRANSCEIVER
322
MEMORY
350
SET-TOP BOX
355
VOICE RECOGNITION AND VOICE SYNTHESIS
360
365
REMOTE CONTROL RECEIVER
338
DISPLAY, DISPLAY DRIVERS, TOUCH SCREEN LOGIC
336
TV PORTS
334
DATA PORTS
332
TELEPHONY PORTS
342
PERIPHERAL PORTS
344
EXTERNAL/INTERNAL INTERCOM MODULE
345
WIRELESS INTERFACE


BILLING OAM&P
195
SMD NETWORK
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200
INTERNET
180
SS7
170
PSTN
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EMG
SG
VG
MG
MS
GS
AS
CM
SM
DHCP TFTP DNS
214
IP CENTRAL STATION
236
255
212
224
240
234
232
230
222
210
220
218
216
238
120n
HPN
UHR
IP LND
122
121
LSMS
150
NPAC
151
LSOA
152
HEH
ER
CMTS
HE
118
116
115
117
HFC PLANT
112
300
BRG
102
CPE
106
110
108

FIG. 4

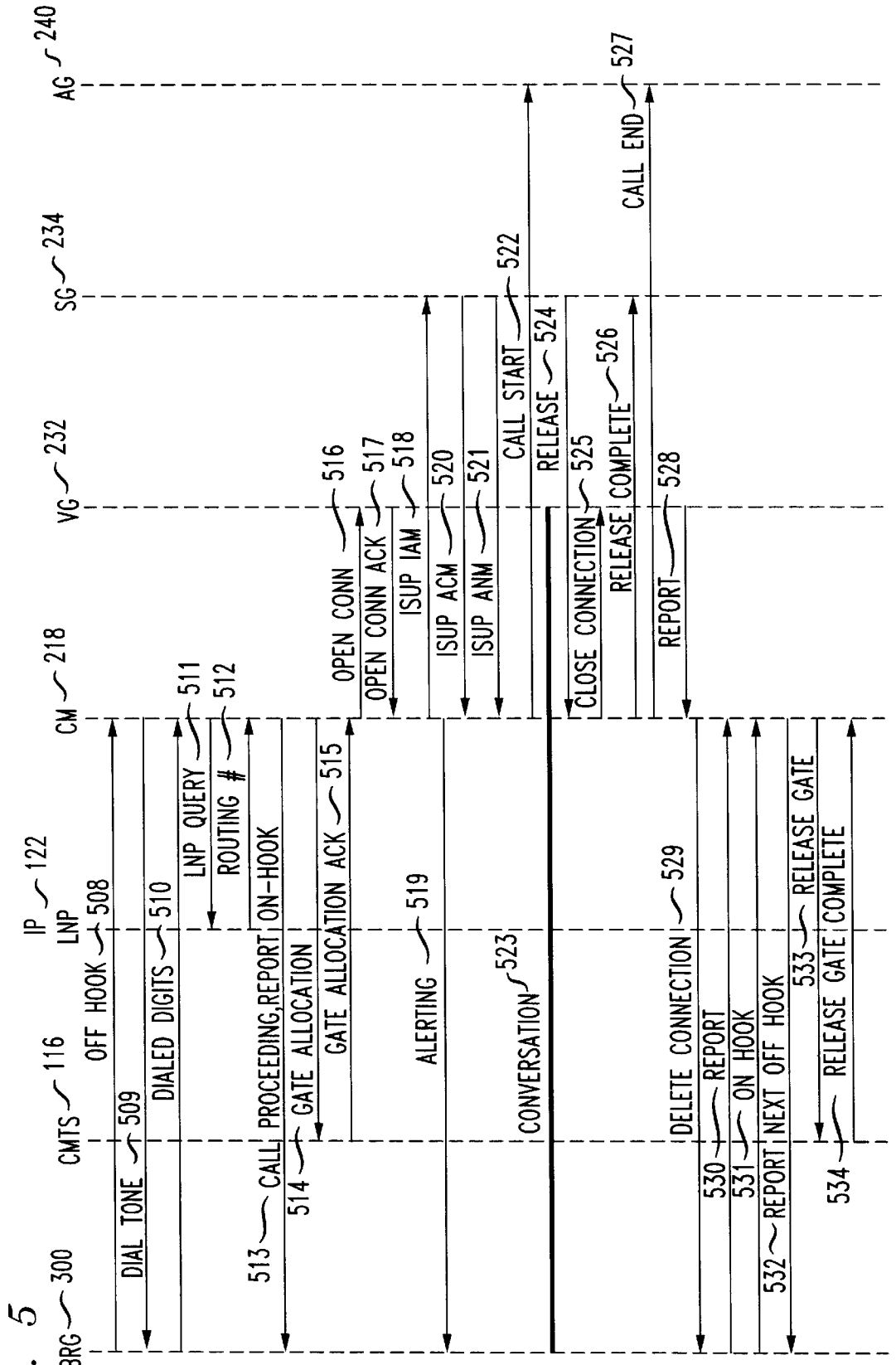
BRG 300
CMTS 116
IP LNP 122
CM 218
VG 232
SG 234
AG 240
DIAL TONE 509
OFF HOOK 508
DIALED DIGITS 510
LNP QUERY 511
ROUTING # 512
CALL PROCEEDING,REPORT ON-HOOK 513
GATE ALLOCATION 514
GATE ALLOCATION ACK 515
OPEN CONN 516
OPEN CONN ACK 517
ISUP IAM 518
ALERTING 519
ISUP ACM 520
ISUP ANM 521
CALL START 522
CONVERSATION 523
RELEASE 524
CLOSE CONNECTION 525
RELEASE COMPLETE 526
CALL END 527
REPORT 528
DELETE CONNECTION 529
REPORT 530
ON HOOK 531
REPORT NEXT OFF HOOK 532
RELEASE GATE 533
RELEASE GATE COMPLETE 534

FIG. 5

FIG. 6

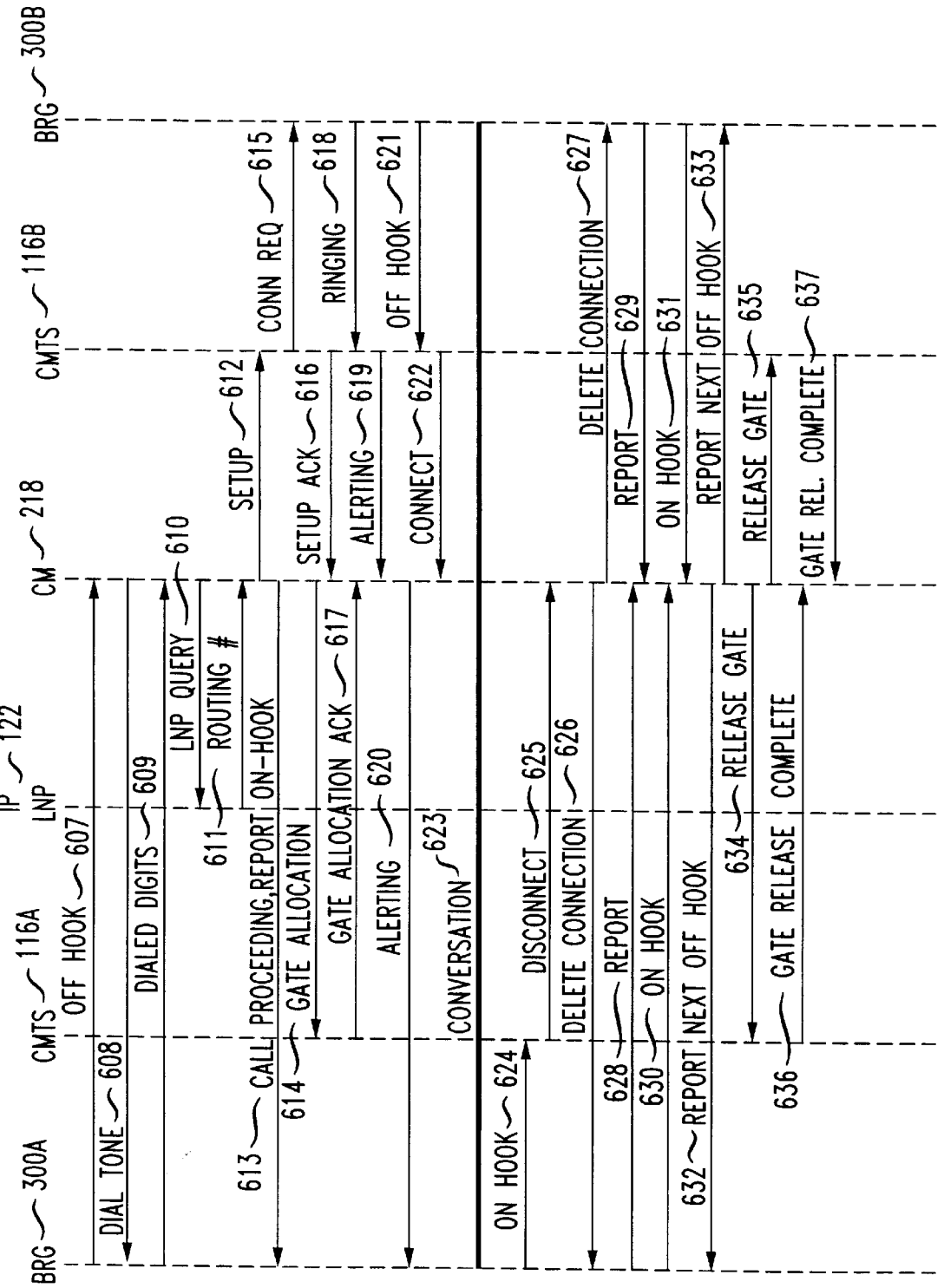
BRG 300A
CMTS 116A
IP LNP 122
CM 218
CMTS 116B
BRG 300B
OFF HOOK 607
DIAL TONE 608
DIALED DIGITS 609
LNP QUERY 610
ROUTING # 611
SETUP 612
CONN REQ 615
CALL PROCEEDING,REPORT ON-HOOK 613
GATE ALLOCATION 614
SETUP ACK 616
GATE ALLOCATION ACK 617
RINGING 618
ALERTING 619
ALERTING 620
OFF HOOK 621
CONNECT 622
CONVERSATION 623
ON HOOK 624
DISCONNECT 625
DELETE CONNECTION 626
DELETE CONNECTION 627
REPORT 628
REPORT 629
ON HOOK 630
ON HOOK 631
REPORT NEXT OFF HOOK 632
REPORT NEXT OFF HOOK 633
RELEASE GATE 634
RELEASE GATE 635
GATE RELEASE COMPLETE 636
GATE REL. COMPLETE 637

FIG. 7a

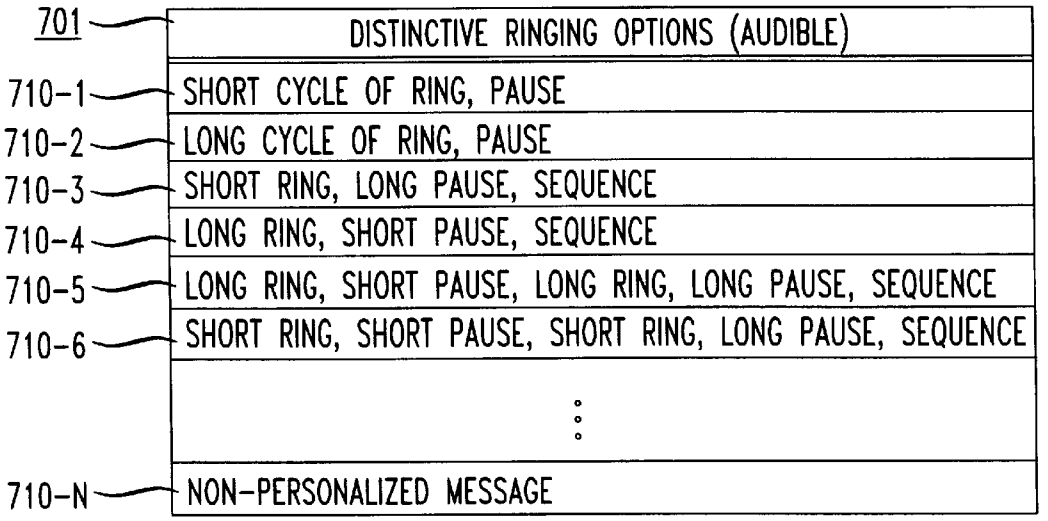

FIG. 7Bb

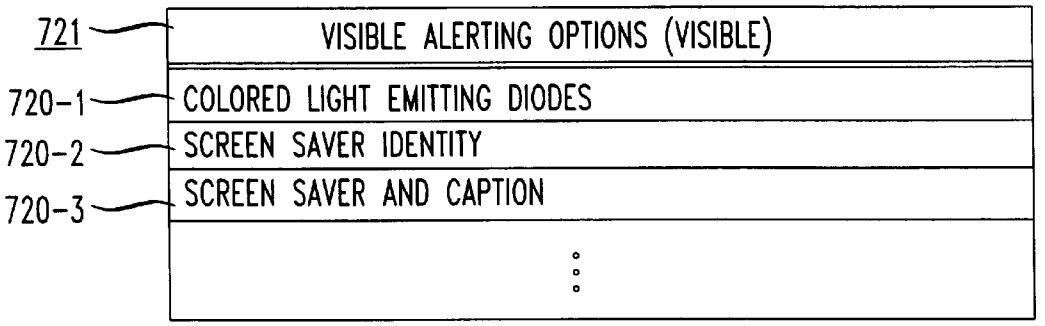

FIG. 7c

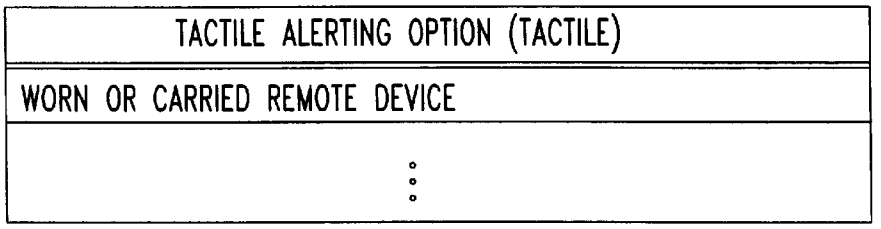

FIG. 8a

CHASE ME SCHEDULE		
ADDRESS	TIME OF DAY	DAYS OF THE WEEK
301 545 1234	7:00AM - 8:00AM; 8:00PM - 10:30PM	MON - FRI
smith@att.com	9:00AM - 7:00PM	MON - FRI
202 508 9157	9:00AM - 7:00AM	MON - FRI
smith@onet.com	7:00AM - 8:00AM; 8:00PM - 10:30PM	MON - FRI
703 508 9230	8:00AM - 9:00AM; 7:00PM - 8:00PM	MON - FRI

FIG. 8b

CALENDAR				
EVENT	TIME OF DAY	DATE	ADDRESS	MESSAGE
CHRISTMAS ⋮	12:00 NOON ⋮	12/25 ⋮	mom@att.com ⋮	
MOM'S BIRTHDAY BUSINESS MEETING	12:00 NOON 9:00AM - 10:00AM	5/15 3/25	mom@att.com	

FIG. 8c

CALLING PARTY PREFERENCE			
CALLING PARTY	PREFERENCE LEVEL	CALLING ADDRESS	IP WEB ADDRESS
MOM	1	301 423 5657	mom@www.com
DAD	1	301 423 5657	dad@www.com
FRIEND	2	301 467 2836	friend@www.com
BOSS	1	301 473 6850	boss@www.com
⋮	⋮	⋮	⋮

FIG. 9

TERMINAL CONFIGURATION
#1 TOSHIBA LAPTOP SOFTWARE CABLE MODEM CHARACTERISTICS
#2 CATV TERMINAL SOFTWARE MODEM CHARACTERISTICS
#3 TELEPHONE STATION
#4 VISIONPHONE STATION

FIG. 10

PREFERENCE LEVEL	INSTRUCTIONS	TIME OF DAY	DAYS OF THE WEEK
#1	CHASE ME, FOLLOW ME, BARGE-IN		
#2	CHASE ME, FOLLOW ME		
#3	WILL ACCEPT IF I AM AVAILABLE		
#4	TAKE MESSAGE		
#5	FATHER		

ENHANCED SUBSCRIBER IP ALERTING

A cross-reference of related applications is provided at the end of the Detailed Description of Preferred Embodiments section of the present application.

FIELD OF THE INVENTION

The present invention relates to methods for alerting subscribers to IP telephony services of a communication where the subscribers may be calling parties as well as called parties and for setting up such subscriber altering from a remote site such as a web site.

BACKGROUND OF THE INVENTION

Present day telephony voice networks have a network built around circuit switches, end offices, a toll network, tandem switches, and a twisted wire pair (forms the subscriber loop between the end office and the subscriber). These voice networks are referred to as a public switched telephone network (PSTN) and their services referred to as plain old telephone service (POTS). Due to bandwidth limitations of plain old telephone service (POTS), there is an inherent inability to efficiently integrate multiple types of media such as telephony, data communication for personal computers (PC), and television (TV) broadcasts. New network alternatives include the Internet and Asynchronous Transfer Mode which provide data packet switching to couple end terminals without having to dedicate a specific circuit between the terminals. Individual packets can travel from point A to point B by any appropriate route. Accordingly, a new broadband architecture is required for integrating alternative networks. This new architecture gives rise to a new array of user services. These new services may include and are not limited to including digital audio sound delivery, video conferencing, video telephony, multimedia messaging, conventional CATV service delivery and the like.

Presently, specialized alerting services may be provided for POTS services by preestablishing ringing tone sequences for alerting a specifically addressed caller, for example, Tom may be signaled by two long rings and a short ring in sequence and Mary via one short and one long ring. So-called distinctive ringing provides the opportunity for two lines to share the same subscriber facility. For example, a subscriber may have a facsimile line and a POTS telephone share the same facility but each have their own telephone number. Shared facilities and telephone numbers in POTS services recalls memories of so-called party lines when a number of households were permitted to share the same facility but privacy of communications were lost as any party sharing the party line could listen in on another party's calls.

Notwithstanding the existence of these special alerting services for conventional telephony, one tendency to date in existent voice over IP (VoIP) telecommunication systems where telephone calls travel via the Internet is to emulate existent telephony alerting arrangements. Alternatively, such alerting arrangements in Internet telephony may comprise signals like "You have mail" or other alerting means different from conventional ringing signals due to the differences between a telephone and a personal computer.

Consequently, there exists a great opportunity to provide new methods and procedures for alerting IP broadband subscribers for multi-media communications including digital audio and digital video.

SUMMARY OF THE INVENTION

Aspects of the invention include providing broadband access capabilities or enhanced services for use in conjunction with a packetized network such as an Internet Protocol (IP) based system infrastructure.

Other aspects of the invention include providing one or more of the following either individually, or in any combination or subcombination:

a new broadband architecture;

broadband network capabilities, including local access;

enhanced multi-media services for use in conjunction with a packetized network such as an Internet Protocol (IP) based system infrastructure;

utilizing a SIM card to validate a user associated with a subscriber or off-premises location;

providing users with choices of alerting systems including the conventional PSTN ringing or personalized ringing systems, and enhanced alerting features such as calling party alerting or called party location;

providing remote capabilities for changing alerting and announcement options associated with alerting a subscriber from a remote site such as a web site; and

providing via camera, motion detection, audible detection and the like personal detection means both an alarm capability and a way of determining when a called user is actually not available to take a call and so automatically choosing not to actuate any alerting.

According to the present invention, a method of alerting a broadband user at a first terminal of an incoming multimedia call from a particular calling party comprises the steps of receiving input data at a broadband gateway of user preferences of calling parties, calling party locations, and terminal configuration data for a terminal normally utilized by the user, alerting a called user by utilizing a user-defined alerting scheme, the scheme including identifying the multimedia call as one specifically intended for the user among a plurality of different users and identifying one of the identity or the location of the calling party, comparing the identity or location with said user preferences and alerting the calling party of the priority of the call, the priority of the call including an indication of whether the called party has left instructions for the calling party.

In accordance with a further embodiment, a method of alerting a broadband user at a first terminal of an incoming multimedia call from a particular calling party comprises the steps of receiving input data at a broadband gateway of user preferences of calling parties, calling party locations, and terminal configuration data for a terminal normally utilized by the user, comparing the user preferences with data describing the incoming multimedia call, and, if the terminal normally utilized by the user is not appropriate for the call, alerting the called user to one of moving to another terminal or arranging to equip said terminal so that the terminal is appropriate for the call.

In accordance with a further embodiment, a method of alerting a broadband user at a first terminal of an incoming multimedia call from a particular calling party comprises the steps of receiving input data at a broadband gateway of user preferences of calling parties, calling party locations, distinctive ringing identity of the user and terminal configuration data for a terminal normally utilized by the user, said input data having been transmitted from one of a remote web site, the remote web site having an identification module receiver for receiving a subscriber identity module containing terminal configuration data.

In accordance with a still further embodiment, a method of automatically determining not to alert a broadband user at a first terminal of an incoming multimedia call from a

particular calling party, the first terminal being equipped with a user detection system comprises the steps of receiving input data at a broadband gateway of user preferences of calling parties, calling party locations, and terminal configuration data for a terminal normally utilized by the user, comparing an identity of a called party with the output of the user detection system, and choosing not to alert a called user if, from the comparison, the called user is not determined to be available by the user detection system.

Although the invention has been defined using the appended claims, these claims are exemplary and limiting to the extent that the invention is meant to include one or more elements from the apparatus and methods described herein and in the applications incorporated by reference in any combination or subcombination. Accordingly, there is any number of alternative combinations for defining the invention, which incorporate one or more elements from the specification (including the drawings, claims, and applications incorporated by reference) in any combinations or subcombinations.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a schematic representation of a broadband network (for example, broadband IP based network) in accordance with a preferred embodiment of aspects of the present invention.

FIG. **2** shows a block diagram of a preferred embodiment of a centralized control (IP central station) in accordance with aspects of the present invention.

FIG. **3** shows a block diagram of a preferred embodiment of a local control apparatus (broadband residential gateway) in accordance with aspects of the present invention.

FIG. **4** shows a detailed schematic representation of an exemplary embodiment of the broadband network shown in FIG. **1**.

FIG. **5** is a signal flow diagram illustrating a typical on-network to off-network call according to one preferred method of operating the broadband network shown in FIG. **1**.

FIG. **6** is a signal flow diagram illustrating a typical on-network to on-network call according to one preferred method of operating the broadband network shown in FIG. **1**.

FIG. **7** is a collection of screen portions which may comprise screens displayed on displays to users of the present invention such as user profile screens, terminal configuration screens and call set up screens; FIG. **7**(*a*) is a representative screen portion whereby a user may select and/or the screen portion may display an audible distinctive ringing pattern; FIG. **7**(*b*) is a representative screen portion whereby a user may select and/or the screen portion may display a visible alerting option; FIG. **7**(*c*) is a representative screen portion whereby a user may select and/or the screen portion may display a remote or tactile alerting option for alerting a user of an incoming communication.

FIG. **8** is a collection of screen portions which may comprise screens displayed on displays to users of a chase me system according to the present invention such as call set up screens, call progress screens and alternative call routing screens; FIG. **8**(*a*) is a representative screen portion whereby a user may select and/or the screen portion may display parameters for a chase me service; FIG. **8**(*b*) is a representative screen portion whereby a user may select and/or the screen portion may display a calendar of events. FIG. **8**(*c*) is one embodiment of a screen or a screen portion whereby the user may select and/or the terminal may display calling party preferences including chase me/follow me instructions for an incoming communication to a user via displays such as user profile screens, terminal configuration screens and call set up screens; for a second or other users for example, there may be associated screens and/or screen portions for each other user.

FIG. **9** is a collection of screen portions which may comprise screens for terminal configuration for entry and display of terminal characteristics including hardware, software and interface characteristics.

FIG. **10** is an example of one embodiment of a call preference screen portion of a display such as a user profile screen, a terminal configuration screen and a call set up screen whereby user may specify a calling party preference level and an associated instruction set for the calling party and their call processing.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

A new system is provided for broadband multimedia access and, in particular, customized alerting applications providing alerting of an incoming multimedia communication in accordance with the user's selection of personalized alerting parameters, calling party preference data and terminal configuration data among other user selections or automatic inputs. Unless otherwise indicated by the appended claims, the present invention is not limited to the preferred embodiments described in this section but is applicable to other integrated multimedia communication systems.

I. Integrated Communication System Overview

Referring to FIG. **1**, an exemplary embodiment of a broadband network **1**. The broadband network generally provides interconnection between a plurality of customer locations utilizing various interconnection architectures including an Internet Protocol (IP) based network, various existing systems (legacy systems) such as the public switched telephone network (PSTN), ATM networks, the Internet, signaling networks, as well as other systems. The broadband network provides versatile intelligent conduits that may carry, for example, Internet Protocol (IP) telephony or multimedia signals between the customer premises over, for example, the public switched telephone network, Internet, or wireless communication networks. All networks shown in FIG. **1** may be generally categorized as either circuit-switched networks or packet-switched or packet-based networks. Circuit-switched networks generally involve the creation of an end-to-end facility that is dedicated to a given communication while packet-switched networks share common facilities; (a data packet is addressed and can follow a plurality of paths to an addressed far end terminal).

Again referring to FIG. **1**, the broadband network **1** may include one or more customer premises equipment (CPE) units **102**. The customer premise equipment **102** may be variously configured. In one example, the customer premise equipment **102** may include one or more local control devices such as a broadband residential gateway (BRG) **300**. Although the broadband residential gateway is preferably disposed in a residence for many aspects of the invention, in exemplary embodiments, it may also be disposed in a business, government or other location. The broadband residential gateway **300** may be variously configured to provide one or more integrated communication interfaces to other devices within the customer premise equipment **102** such as televisions (TV), personal computers (PC), plain old

telephone system (POTS) phone(s), video phones, IP enabled phones, and other devices. For example, the broadband residential gateway **300** may provide one or more telephone port connections (for example, plain old telephone system), Ethernet connections, coaxial connections, fiber distributed data interface (FDDI) connections, wireless local area network (LAN) connections, firewire connections, and/or other connections to a plurality of devices such as plain old telephones, IP based phones, television converters, for example, cable television (CATV) set top devices, televisions, digital televisions, high definition televisions (HDTV), video phones, surveillance system devices including microphones and cameras and other devices. In exemplary embodiments, the broadband residential gateway **300** may support communications between any of the aforementioned devices in intra-premises calling and/or extra-premises calling. The BRG **300** takes an inventory of addresses of all connected apparatus and may report terminal capabilities (a terminal configuration) to a call manager of an IP Central Station **200** (FIG. **2**), as will be further discussed herein, to enable multimedia capabilities compatible with called party multimedia capabilities. Further, when the broadband residential gateway **300** is used in a business or government environment, it can function as a private branch exchange or key type telephone system.

In FIG. **1**, broadband residential gateway **300** is illustrated as a single physical device. This configuration is appropriate where centralization of maintenance and control is desirable. Alternatively, the broadband residential gateway **300** may be separated into more than one physical device allowing functionality to be distributed to a plurality of different physical locations in the customer premise and/or broadband network **1**. However, in many embodiments, having a centralized broadband residential gateway **300** located in a single location provides ease of maintenance, control, and re-configuration as well as a reduction in cost due to shared functionality. For example, the broadband residential gateway may be configured to provide the intelligence needed to allow each of the customer premises equipment devices to operate within the broadband network **1**. For example, analog voice may be converted to digital data and packetized for transmission in an appropriate output protocol such as an Internet protocol (IP).

In exemplary embodiments, the broadband residential gateway **300** may function to couple devices within the customer premise equipment **102** to the rest of the broadband network **1** using any suitable broadband communication mechanism. In the embodiment shown in FIG. **1**, the broadband residential gateway **300** utilizes a hybrid fiber-coaxial plant **112** to couple the broadband residential gateway **300** to the rest of the broadband network **1**. The hybrid fiber-coaxial plant **112** may be preferred in many embodiments over other broadband communication mechanisms because of the large number of homes currently connected to cable networks, the capacity for shared access, and the ability for asymmetric data access speeds which allow high quantities of data to be distributed to the various devices in the customer premises equipment **112**. The hybrid fiber-coaxial plant **112** may include coaxial cable and/or optical fiber networks in any suitable combination. The hybrid fiber-coaxial plant **112** may provide an intelligent broadband conduit between the broadband residential gateway **300** and a gateway such as the head-end hub (HEH) **115**. The head-end hub **115** may be variously configured to provide various services and/or interconnections with the rest of the broadband network **1**. For example, the head-end hub **115** may provide an interconnection point to gather and aggregate external services (for example, off air and satellite video, public switched telephone network voice, multimedia messages, and Internet data) for distribution to and from the hybrid fiber-coaxial plant **112**. With respect to telephony and multimedia calls, the head-end hub **115** may function as intelligent conduit for connection and communication between the hybrid fiber-coaxial plant **112** and external networks such as an IP network **120** and/or an ATM/frame relay/cell relay network **185**.

The broadband network **1** may include any number of interconnected head-end hubs **115**, IP networks **120**, and/or ATM networks **185**. Further, the IP network **120** and/or ATM network **185** may be connected to one or more other networks and devices such as:

(1) external networks including a public switched telephone network (PSTN) **170**, an signaling system seven (SS7) network **170**, an Internet **180**, and/or a wireless network **144**;

(2) various components including one or more private branch exchanges **146**, terminals **142** including computers and wireless devices, and/or one or more stand alone broadband residential gateway **300**;

(3) one or more administration centers **155**;

(4) one or more secure network management data networks **190** such as a network operations center (NOC);

(5) one or more billing systems **195** such as OSS; and/or

(6) one or more centralized control centers such as what is referred to as an IP central station **200**.

The IP network **120** and/or ATM network **185** (examples of packet-switched networks) may include one or more routers and/or other devices to route, for example, telephony calls, multimedia calls, signaling messages, administrative messages, programming messages and/or computer data between the various devices in the broadband network **1** such as the head-end hub **115**, the public switched telephone network **160**, the private branch exchange (PBX) **146**, as well as the other devices discussed above. In preferred embodiments, the information traveling in the IP network **120** may be packetized and formatted in accordance with one of the Internet protocols. The IP network **120** may also include gateways to interface with the various other networks and/or devices. For example, the gateways may be distributed at the edge of the IP network where the IP network interfaces with one of the other devices or networks. Alternatively, the gateways interfacing the IP central station **200** to, for example, the Internet **180**, public switched telephone network (PSTN) **160**, signaling system 7 (SS7) **170**, wireless networks **144**, ATM/frame/cell relay networks **185** may be provided in the IP central station **200**, or in both the IP network **120** and the IP central station **200**, and/or partially distributed between the IP network **120** and the IP central station **200**. Where the gateways are separated by an IP network **200**, an appropriate transport protocol may be utilized to logically connect the IP central station **200** to the particular gateway.

The IP central station(s) **200** may be connected to, for example, one or more IP networks **120**, ATM networks **185**, secure management data networks **190**, and/or administration centers **155**. The IP central station **200** may be variously configured to include one or more servers and/or one or more gateways. In exemplary embodiments, the servers and gateways provide the necessary intelligence and traffic management capabilities to enable information, for example, IP telephony signals, to travel through the broadband network **1**. For example, the IP central station **200** may be configured to manage voice information transfer from the public

switched telephone network **160**, through the IP network **120**, and into and out of one or more devices such as those connected to a broadband residential gateway **300**. The IP central station may be configured to store various control and system information such as location, address, and/or configurations of one or more broadband residential gateways **300**, as well as other routing and call set-up information.

In exemplary embodiments, one or more administration centers **155** may be connected to the IP network **120** and provide billing and local directory number portability administration. The local number portability may be handled by one or more Local Service Management System (LSMS) which may be included in the administration center **155** and/or in the IP central station **200**. Further, the Secure Management Data Network **190** may also include a mechanism for transferring various information such as billing, call tracking, and/or customer service provisioning. Various existing systems may be utilized to provide this information such as existing billing systems (OSS) **195** and/or one or more network operations center (NOC). The network operations centers may be included in the administration center **155**, the IP central station **200**, and/or the billing system **195**. The network operations center (NOC) may be variously configured to include a translation server to allow communications with the various disparate entities (for example, legacy systems) in the broadband network **1**.

The IP network **120** and/or the ATM network **185** illustrated in FIG. **1** may include one or a plurality of sub-networks. Each of the sub-networks may include its own IP central station **200** in a distributed configuration, with certain routing data replicated across all IP central stations or each sub-network may be connected to a single centralized IP central station **200**. Where the IP network **120** includes one or more sub-networks, each sub-network may be connected to multiple head-end hubs **115**. Further, each head-end hub **115** may be connected to multiple hybrid fiber-coaxial plants **112**, and each hybrid fiber-coaxial plant **112** may be connected to multiple pieces of customer premises equipment **102** and/or broadband residential gateways **300**. The IP network **120** provides an interconnected broadband network which may be utilized to transport and route packetized information to and from diverse geographic locations and may be used on a national or international basis. Further, the IP network **120** and/or ATM network **185** may utilize private network facilities and/or may be provisioned over a shared network such as the Internet.

The IP central station **200** may be configured to provide connectivity for the broadband residential gateway **300** to the Internet **180** (for example, World Wide Web (www)), as well as connectivity to other external networks such as public switched telephone network **160** and signaling system seven (SS7) **170** for end-to-end voice, multimedia, and data applications, for example voice over IP telephony. IP packets traveling through the IP network provide for priority so that, for example, voice packets may be typically given priority over data packets to maintain certain VoIP telephony QoS requirements. On the other hand, a leased line concept for packet traffic may have an even higher priority than a voice communication. According to the principle of the present invention, a user may change alerting options, calling party preference data and terminal configuration data and, hence, the priority of the communication in real time in response to user input. Thus, the system is sufficiently flexible so that the priority of a given communication can be dynamically altered according to customer preferences.

A. Internet Protocol Central Station

Referring to FIG. **2**, the IP central station **200** may be variously configured. In preferred embodiments, it may be configured to ensure seamless integration of packet based communication system including the IP network **120** with the public switched telephone network **160**, signaling system 7 (SS7) network **170**, and the Internet **180** so that packetized data, for example, voice calls and information data, is properly transferred between the broadband residential gateway **300**, the public switched telephone network **160** and/or the Internet **180**. In one embodiment, the hybrid fiber-coaxial plant **112**, head-end hub **115**, and IP network **120**, provide a virtual signaling conduit for packetized voice and data which may, with the coordination of the IP central station **200**, be provided in the appropriate format between the broadband residential gateway **300** and the public switched telephone network **160** and/or Internet **180**.

Again referring now to FIG. **2**, the IP central station **200** may include a central router **210**, for example, a gigabit switch, which may be utilized to interconnect various servers and gateways contained in the IP central station **200**. The central router **210** provides for example Ethernet switching and aggregates traffic between servers, gateways and the IP network **120** and/or ATM network **185** backbone. In one exemplary embodiment, the central router **210** provides high-speed, non-blocking IP and IP multicast Layer **3** switching and routing. The IP central station **200** may include one or more of the following servers: the least cost server (LCS) **255**, the time of day (TOD) server **212**, the dynamic host control protocol (DHCP) server, the trivial file transfer protocol (TFTP) server, and the domain name service (DNS) server **214**, the system management (SM) server **216**, the call manager (CM) server **218**, the announcement server (AS) **220**, the multimedia server (MS) **222**, and/or the conference server (CS) **224**. As illustrated in FIG. **2**, the servers may be separate servers, for example the call manager server **218**, or may be incorporated into a single server. In the exemplary embodiment, the dynamic host control protocol server **131**. trivial file transfer protocol server server **132**, and the domain name service server **214** are each incorporated in a single server facility. Each server in the IP central station **200** may include computer(s), storage device(s), and specialized software for implementing particular predefined functions associated with each server. In this manner, the servers in the IP central station may be provisioned as a main server and one or more back-up servers to provide redundant processing capabilities. Similarly, the router may be implemented as a main router and a back-up router with similar routing functionality.

The IP central station **200** may also include, for example, one or more of the following gateways: an element management gateway (EMG) **238**, an accounting gateway (AG) **240**, an Internet (Boarder) gateway (IG) **236**, a signaling system 7 (SS7)) gateway (SG) **234**, a voice gateway (VG) **232**, and/or a multimedia gateway (MG) **230**. The IP central station **200** may utilize one or more of these gateways to provide centralized system intelligence and control of voice and/or data IP packets.

In exemplary embodiments, the dynamic host control protocol server and domain name service server **214** may operate to dynamically assign IP addresses to devices in the customer premise equipment **102**. This server **214** is also remotely addressable by telephone or by way of the world wide web and provides an IP address or telephone number for the central station **200** so it can be remotely accessed by a user. Consequently, a user may communicate with their

central station from a remote web site or by telephone as will be further discussed herein. Where a dynamic IP assignment scheme is used; the customer premises equipment may be provided with one or a plurality of dynamic IP assignment when activated initially, and/or at the initiation of each active session. Where an IP address is assigned when the device is initially activated, it may be desirable to assign a single IP address to a single broadband residential gateway and assign a port address to devices connected to the broadband residential gateway **300**. In other embodiments, an individual IP address may be assigned to each device coupled to the broadband residential gateway **300**. For example, the broadband residential gateway may include and/or be coupled to one or more cable modems, IP phones, plain old telephone system phones, computers, wireless devices, CATV converters, video phones, surveillance systems and/or other devices which each may be assigned a unique static and/or dynamic IP address and/or a port of a one of these IP addresses. Each of these different terminal devices may have different capabilities for different multimedia services: the telephone is limited to voice telephony while a fully equipped personal computer (including a video camera and microphone) has full multimedia broadband capabilities. As will be discussed further herein, the user may request a communication that cannot be accomplished by the terminal configuration and the BRG may appropriately alert the user move to another terminal that does have such capabilities.

The particular protocol for allocating IP addresses and/or ports may be specified using protocols defined in the dynamic host control protocol server **214**. In exemplary embodiments, the dynamic host control protocol and DN server **214** may be configured to assign available IP addresses from address pools based, for example, on the identity or type of requesting device, the amount of use expected for the requesting device, and/or predefined assignment protocols defined in the dynamic host control protocol and DN server **214**. The identifiers provided for given equipment and temporarily stored at a broadband residential gateway can be translated to provide capabilities for, for example, for high fidelity audio reception and transmission, high definition television reception or transmission and the like at a given user location within a residence, business or government location and thus reported to an IP central station **200** at call set-up. In centralized embodiments, it may be desirable to configure the call manager (CM) **218** to provide sufficient information such that the domain name service server **214** can distinguish between static IP devices, dynamic IP devices, registered devices, unregistered devices, and registered devices that have been assigned to a particular class of service for example, data vs. telephony, un-provisioned, vs. provisioned, etc.

The trivial file transfer protocol (TFTP) server **214** may be configured to transfer certain information to/from one or more broadband residential gateways **300**. In exemplary embodiments, the trivial file transfer protocol server provides Data Over Cable Service Interface Specifications (DOCSIS) configuration information containing QoS parameters, terminal configuration and other information required for the broadband residential gateway **300** to operate optimally.

The time-of-day (TOD) server **212** may include a suitable facility for maintaining a real time clock such as an RFC868-compliant time server. In exemplary embodiments, the time-of-day server **212** provides system messages and/or responses to system inquiries containing a coordinated time, for example, universal coordinated time (UCT). The universal coordinated time may be used by any of the servers and/or devices in the broadband network **1**. For example, the broadband residential gateway **300** may use the universal coordinated time to calculate the local time for time-stamping of communication processing, files and logs, including error logs. User schedules for acceptance/rejection or otherwise prioritization of calls or for surveillance monitoring of a premises or energy management purposes and the like may be clocked by the time-of-day clock server **212**.

The system management (SM) server **216** may include responsibility for the overall operational state and functioning of components the broadband network **1**, either alone, or in combination with other system management servers **216**. The system management (SM) server **216** may be variously configured to provide monitoring and administrative functions for devices within the broadband network **1**. For example, the system management server **216** may be configured to provide management of various database functions, memory buffer functions, and software utility functions within the broadband network **1**. Software management includes, for example, version control, generic control, and/or module control. In accordance with the present invention, remote subscriber and other emergency alerting may be provided when a surveillance system or fire alarm system or the like reports an emergency condition to the central station **200**. For example, if a camera or microphone system is tampered with, the BRG **300** may report the alarm to the central station **200** for action.

The least cost server (LCS) **255** may be variously configured to enable the system to determine alternative routes available for a communication and the least cost routing of telephone and data transmission throughout the network. The least cost server **255** coordinates with the TFTP server **214** to obtain remote terminal configuration data as necessary.

The announcement service (AS) server **220** may be variously configured. In exemplary embodiments, it may store and send announcements to specified destinations and/or all destinations based on instructions received by, for example, the call manager (CM) server **218**. The announcement server **220** receives, for example, Media Gateway Control Protocol (MGCP) or later signaling (for example, H.GCP—an ITU standard Gateway Control Protocol) control messages from the call manager **218**, and sends announcements to one or more voice gateways (VG) **232** and/or the one or more broadband residential gateway **300** (for example, using Real Time Protocol (RTP) packets). The announcement server **220** may send an announcement once, a predetermined number of times, or in a continuous loop. The announcement server **220** may detect when a phone or other device has been taken off-hook and play an advertisement or other announcement to the user. Where a user has signed-up for an advertising plan whereby phone rates are reduced in return for advertising revenue generated by the advertisements, the announcement server **220** may be utilized to track the number of individuals with a particular income, age, or other profile which hear the advertisement. The announcement server **220** may respond to requests from individual system devices such as one of the broadband residential gateways **300** and/or under control of, for example, the call manager **218**. Where the announcement server is under control of the call manager **218**, the call manager may be configured to control various operating parameters of the announcement server. For example, the call manager **218** may request that certain announcements are sent once, a specified number of times, or in a continuous loop.

In accordance with the present invention, the announcement server provides specialized messages to calling parties

regarding the status of a call, for example, whether the called party is actually not at home as reported by surveillance system and visionphone camera, and other personal detection apparatus coupled to the BRG **300**. The announcement server **220** may provide a calling party the opportunity to chase the called party if the priority level of the calling party is sufficiently high or to record a message for delivery via paging or even a multimedia message via the multimedia server **222**.

In still further embodiments, announcements may be generated elsewhere in the broadband network **1**, stored as files, and distributed to one or more announcement servers via a file transfer protocol or resource such as the trivial file server **214** using one or more file transfer protocols. In many embodiments, it is desirable to store announcements in an appropriate encoding format (for example, G.711 or G.729) within the Announcement Server. The announcement may have an audio component and/or a audio/video component. The audio/video component may be stored using a combination of an encoding format (for example, G.711) and/or a standard file format such as wave (WAV), MPEG, and other suitable formats.

In one exemplary method of operation, a user picks up a visionphone which sends a signal to the call manager **218**. Subsequently, the call manager **218** may establish a connection to the announcement server **220** and play one or more pre-recorded and/or predetermined announcement (hypertext and/or audio and/or video). Signaling tones such as dial tone, audible ringing tone, or a called party busy signal may be played by the broadband residential gateway **300** or the call manager **218**, but Special Information Tones (SIT) and/or multimedia messages may also be included as part of an announcement file. In this way, the user experience is enhanced such that a calling party may receive, depending on their priority, a busy message and/or hypertext multimedia announcement providing one of several options for contacting the called party or leaving a multimedia message. The announcement server **220** may have information entered by a user using, for example, a broadband residential gateway **140** to provide additional information to the called party. The additional information may include the ability to leave a multimedia message, type-in a chat note, leave voice-mail, store a facsimile, page the called party, barge-in on an existing call to the called party, and/or other user or system defined call handling capabilities.

The announcement server **220** may also be programmed with various system messages such as an announcement indicating that a number dialed is incorrect or that the call did not go through as dialed, that the lines are busy, that all lines between two countries are currently busy, that the called party has changed numbers, that the called party's phone has been disconnected, that one or more system errors have occurred, that the called party is physically not there and would the calling party like the system to chase the called party or leave a message and/or other announcement messages.

The call manager (CM) **218** may be variously configured. In exemplary embodiments, the call manager **218** provides a centralized call control center for supporting call set-up, call change and tear-down in the broadband network **1**. The call manager **218** may be configured to include trunk and line information maintenance, call state maintenance for the duration of a call, and/or user service features execution. The call manager **218** may also provide for call processing functions such as a standardized call model for processing the various voice connections such as voice over IP calls. In exemplary embodiments a standardized "open" call model may be utilized which supports standardized application programming interfaces (APIs) to provide transport services and other user functions such as calling cards. An open application programming interface and call set-up interface in the call manager enables third party applications to be loaded into the call manager **218** and broadband residential gateway **300**. This will facilitate the development of third party applications for enhancing the functionality of components in the broadband network **1**. For example, third parties and other equipment vendors may manufacture various broadband residential gateways **300** for use in the broadband network **1** by writing applications to support the open call model of the call manager **218**. The call manager **218** and/or broadband residential gateway **300** may also be configured to execute and/or accept commands form a standardized scripting language which may generate instructions for the call manager **218** and/or broadband residential gateway **300** to execute various functions. The scripting functionality may include the ability to execute an entire call model including interfaces to the signaling system 7 (SS7) **170**, public switched telephone network **160**, IP network **120**, ATM/frame/cell relay network **185**, and/or other functions within, for example, IP central station **200** such as the multimedia server **222**, announcement server **220**, system management server **216**, conference server **224**, time of day server **212**, least cost server **255**, and/or domain name server **214**.

The call manager **218** may also be configured to maintain the call states for each call it handles (for example, a voice over IP call) and respond to system events created by, for example, the multimedia gateway control protocol (MGCP) messages and/or integrated services digital network user part (ISUP) messages for signaling system 7 (SS7) protocol that may occur during the processing of a call. Exemplary events handled by the call manager **218** include call state changes, call feature changes/call feature triggering events, changes in the status of lines and trunks, and/or error conditions. Further, the call manager **218** may interact with devices connected to a single circuit on the public switched telephone network **160** and/or a device connected to a port of the broadband residential gateway **300**. In this manner, new devices may be added to the infrastructure and operate using the open call model contained in the call manager **218**.

The call manager **218** may also include storage for subscriber and network configuration, a cache server for faster access to frequently used data, a routing engine for selecting an appropriate routing algorithm (for example, least cost, best quality of service routing), and/or a service broker which provides the data and logic for specific services. In addition, the call manager **218** may include an authentication (AC) server **245** that provides authentication of various devices, objects, packets and users in the integrated multimedia system. Typically, a user carries a subscriber identity module including preferred terminal configuration data, their identity, personal profile and default qos and call set-up parameter data. In this manner, a user may verify the identity of the calling or called party or the call manager may authenticate a user as a subscriber.

The call manager **218** may interact with the signaling gateway (SG) **234**, the accounting gateway (AG) **240**, the element management gateway (EMG) **238**, the voice gateway (VG) **232**, and the multimedia gateway (MG) **230** using any suitable protocol such as IP and an interconnection mechanism such as the central router **210**. In one preferred embodiment, the call manager **218** may be configured to utilize signaling messages such as: a) ISUP messages over Common Object Broker Architecture (COBRA) interface to

and/or from signaling gateway **234**, b) MGCP, SIP—simple internet protocol, H.GCP, and/or other suitable control messages to and/or from the announcement server **220**, c) call event records in modified Radius format to the accounting gateway **240**, d) Radius (or Enhanced Radius or compatible protocol) control messages to and/or from the voice gateway **232** and/or the broadband residential gateways **140**, **300**, and e) signaling network management protocol (SNMP) messages to and/or from the element management gateway **238**.

The call manager **218** may incorporate one or more databases. For example, the call manager **218** may include database information such as (1) a resources database that provides an identification of what resources are connected to the broadband network **1** and their current state; (2) a trunk/gateway database that indicates which gateway serves what circuits in a trunk; (3) a customer database including a user's personal profile which indicates whether a call is authorized, caller preference data, identifies what services a line supports and determines whether a telephone number is on or off the integrated IP communication network; (4) a numbering plan/least cost routing database which provides routing information that enables the IP central station **200** to choose the correct trunk as a function of the called number; and (5) a local number portability (LNP) database that indicates the North American Numbering Plan (NANP) and associated prefixes which are open for association with the number portability service; and (6) an address of the service control point (SCP) towards which requests for translating these local portability numbers should be routed.

In exemplary embodiments, the broadband network **1** includes equipment compatible with the COBRA standard. COBRA may be utilized to allow applications from a plurality of vendors to operate with each other. The COBRA standard allows a company, such as AT&T, to build its network using multi-vendor equipment and yet ensure seamless integration and operation. Some of the major areas covered by COBRA v. 2.2 includes: Inter-ORB Bridge Support, General Inter-ORB Protocol (GIOP) support, Internet Inter-ORB Protocol (IIOP) support, and Environment Specific Inter-ORB Protocol (ESIOP) support. The call manager **218** may integrate these protocols to facilitate call set-up with diverse equipment. This is advantageous in that equipment from a plurality of vendors may inter-operate over the broadband network **1** without modification.

The multimedia server (MS) **222** may be variously configured. For example, one or more multimedia servers may provide support for multimedia messaging service and/or the overall management of multimedia voice and mail messages transmitted across the broadband network **1**. The multimedia server **222** may be configured to support e-mail (for example, html) messages, voice mail (audio) messages, and/or video mail (audio and video) messages. The multimedia messages may include standard pre-configured system messages, advertising messages, and/or user defined messages. The multimedia server **222** also comprises appropriate conversion capabilities such as text to speech, speech to text, optical character recognition, language translation algorithms and the like. In any of the cases of user-defined messages, caller defined messages or system defined messages, where the messages are stored in a centralized location, the multimedia server may provide such storage. Where the multimedia server **222** provides storage for the multimedia messages, a database may be utilized for indexing, storage, and retrieval of such messages. In exemplary systems, the user may access predetermined ones of these messages. The multimedia server **222** may utilize IP as a method of communicating with other devices across the broadband network **1**.

The conference server (CS) **224** may be configured to provide for multiparty conference calls using, for example, IP voice packets during an IP telephony or multimedia session call (for the latter, the conference server coordinates with the multimedia server). The conference server **224** may include specialized software that runs on a computing platform having associated multiplexing and demultiplexing capability for segregating and aggregating user information packets. For example, the conference server may log several calls into a conference session. When information packets are sent from one or more phones, they are aggregated and sent to the other terminals on the conference call, depending on their capabilities for multimedia transmission and/or reception. The conference server **224** may use any suitable communication protocol such as H.GCP or SIP. The conference server **224** may function to aggregate user information from two or more users onto a single call path. The conference server **224** may include one or more "call-in numbers" and be controlled from any location, for example, a centralized operator location and/or one or more broadband residential gateways **300** or IP central stations. A called party may be added to/deleted from a call and given/denied call privileges in real time in response to user input via the broadband residential gateway and the call manager of the IP central station. It may be desirable to have the conference server **224** configured such that some called parties simply monitor the call without voice interruption while other callers have both voice transmit and receive capabilities. Where a caller is not given the privileges associated with active participation in the call, data packets from these users are discarded. For example, a CEO may have a multimedia conference call with a plurality of financial advisors and invite the press to listen on the call and have multimedia access without interruption capabilities. The resources available for various called parties (high fidelity audio transmission/reception, high definition video transmission/reception) may be provided at call set up by polling a BRG for terminal configuration information or identification verification of a called party or during a call as it is desired to add a called party to a call.

The gateways in the IP central station **200** may be configured to provide translation of signals to and/or from the various servers in the IP central station **200**, the IP network **120**, the public switched telephone network **160**, the signaling system 7 (SS7) network **170**, the Internet **180**, and/or the secured management data (SMD) network **190**. The gateways typically support one or more of the following group of functions: call processing; signaling system 7 (SS7) connectivity; billing support; OAM&P support; connection to public switched telephone network; control CoS/QoS parameters; and enhanced services.

The voice gateway (VG) **232** may be connected to the public switched telephone network **160** and operate to convert between IP based voice packets and standard public switched telephone network **160** voice traffic. Voice gateway **232** may be configured as multi-frequency (MF) or ISUP gateways on a per-T1 basis. Where multi-frequency (MF) trunks are used, one embodiment utilizes signaling between the call manager **218** and the voice gateway **232** using MGCP, SIP, H.GCP and/or other compatible protocol. Multi-frequency trunks may be compatible with Feature Group D (FGD), Operator Service (OS) Signaling protocol and/or Termination Protocol (TP).

The IP central station **200** may be variously connected to the public switched telephone network. For example, the IP central station **200** may be connected directly to the public switched telephone network using, for example. a bearer

channel (for example, a T1 or T3 carrier) and/or interconnected using one or more networks such as an IP network and/or ATM/frame/cell relay network **185**. Where a T1 network is utilized, it may be desirable to utilize one or more of ISUP or MF, FGD, and OS to interconnect a service bureau in the public switched telephone network **160**. Alternatively, the service bureau in the public switched telephone network **160** may be interconnected using an alternative network arrangement such as an IP network **120** and/or a ATM/frame/cell relay network **185**. The service bureau may coordinate with the IP central station **200** in providing operator services, directory services and provisioning for 311, 611, and 711 services. Emergency 911 services may be routed to an E911 tandem switch that has the appropriate databases and interfaces with a Public Safety Answering Position (PSAP). Emergency 911 services including automatic alarm reporting and chase me alarm reporting to a subscriber may be coordinated by the call manager **218** and/or public switched telephone network based service bureau.

Voice gateway **232** may be router-based and include one or more voice feature cards and/or DSP Module cards to perform voice processing. The voice gateway **232** may optionally include host processors, LAN/WAN ports, Ethernet ports, T1 or E1 telephony interface cards, Voice Feature Cards with DSP Modules providing voice compression transcoding (G.711 and G.729), carrier-quality echo cancellation with 8 ms–32 ms tail length, a de-jitter buffer which adapts to delay variations in the network in order to minimize the delay, packet loss concealment that generates concealment frames for lost packets using information from previously received data, and/or tone detection and generation. This function detects Multi-Frequency (MF) tones and generates MF and call processing tones (for example, dial tone, callwaiting tone etc.).

In exemplary embodiments, the voice gateway **232** may include T1/E1 interfaces with internal Channel Service Units (CSUs). It may also be desirable to configure the voice gateway **232** such that ISUP, MF and Centralized Attendant Services (CAS) trunks are supported with a configuration done on a per T1 basis. Additionally, multi-frequency tones and Centralized Attendant Services may utilize a "robbed bits" communication scheme where bits are "robbed" from sub-frames to transmit in-band signaling. The multi-frequency tones may be converted to and/or from, for example, simple gateway control protocol (SGCP) signal requests and events by the voice gateway **232**. For example, multi-frequency tones and/or lower level signaling and timing functions may be translated to and/or from any of the following indications: simple gateway control protocol Notify functions, simple gateway control protocol Notification Requests, Connection requests, Modify Connection requests, off-hook and/or on-hook indications.

An Ethernet interlace with a RJ-45 connector may be used to connect the voice gateway **232** to the central router **210** (for example, Gigabit Switch or High Speed Router (HSR)). The multimedia gateway control protocol may be used as the interface between the voice gateway **232** and the call manager **218**. For example, call control, signaling, and multimedia data stream, real time protocol (RTP) connections, IP addresses, UDP ports, codec choice etc, may be configured in any suitable manner such as by using a multimedia gateway control protocol. In exemplary embodiments, audio streams may be passed directly between customer premises equipment **102** using real time protocol connections over, for example, a user datagram protocol (UDP). Thus, the multimedia gateway control protocol may be utilized to request the voice gateway **232** to initiate, cancel, and/or otherwise modify connections in order to set up and tear down RTP media streams. A similar procedure may also be utilized to request continuity tests and results.

In exemplary embodiments, it may be desirable to adapt the IP network to carry signaling system 7 (SS7) Transaction Capabilities Application Part (TCAP) messages over the IP network **120** and/or the ATM/frame/cell relay network **185**. The transport of signaling system 7 (SS7) transaction capabilities application part (TCAP) messages over the packet networks allows signaling operations to be supported by multiple connections to the same host, multiple host connections, and distributed processing of call set-up information using, for example, multiple call managers **218** in the broadband network **1**. Thus, the IP network **120** and/or ATM/frame/cell relay network may be utilized to interconnect a plurality of ESS switches to transport signaling information, voice, and/or data. In embodiments where the signaling gateway (SG) **234** is configured to support signaling system 7 (SS7) signaling transport using transaction capabilities application part (TCAP) messages, it may be desirable to include a translator for converting between multimedia gateway control protocol (MGCP) messages and transaction capabilities application part (TCAP) messages and/or ISDN User Part (ISUP) messages.

The point where ISUP and TCAP messages are terminated at a signaling system 7 (SS7) signaling gateway is defined as a Service Switching Point (SSP) to the signaling system 7 (SS7) network **170**. The call manager **218** may be configured with a standardized Application Programming Interface (API) to allow interaction with the signaling system 7 (SS7) by, for example, sending and/or receiving ISUP and TCAP messages from a service switching point (SSP). Full class **5** signaling system 7 (SS7) functionality may be included in the call manager **218** including the ability to provide all of the information necessary for billing as defined in the GR-246-Bellcore standard. The signaling gateway **234** may be arranged to perform: signaling system 7 (SS7) message handling (message discrimination, message distribution, and message routing); signaling link management (for example, link activation, deactivation); signaling route management (managing Point Code [PC] route status based on route received management messages such as Transfer Prohibited, Transfer Allowed, Transfer Restricted, etc.); and signaling traffic management (diversion of traffic based on unavailability, availability, restriction of signaling link, route, and Point Code.) The signaling system 7 (SS7) architecture supports the necessary redundancy component scheme for system reliability and availability during scheduled maintenance and/or software/hardware upgrades. The signaling gateway **234** may be configured to directly provide for lower level signaling system 7 (SS7) processing.

In exemplary embodiments, the signaling gateway **234** interacts with the call manager **218** using an appropriate open interface (for example, Common Object Request Broker Architecture (COBRA)). In these embodiments, it may be desirable for translation software in the signaling gateway **234** to add Message Transfer Part (MTP) layer information to the ISUP and/or TCAP data to create a complete signaling system 7 (SS7) message. The complete signaling system 7 message may then be sent to the Signaling Transfer Point (STP) in the external signaling system 7 (SS7) network **170**. Conversely, the signaling gateway **234** may be configured to remove ISUP or TCAP application layer data from the signaling system 7 (SS7) messages received from the STP prior to converting the information to an appropriate open interface (for example, COBRA) and forwarding the information to the call manager **218** via the central router **210**.

The accounting gateway (AG) **240** may be configured to receive messages representing events from the call manager **218** via a suitable transport mechanism such as the central router **210**. Typically, two messages are received for each call, the first when the call is established, and second when the call terminates. Messages are also generated in real time in response to user input when there is a change, for example, of required bit rate, quality of service, preferred service provider for a segment of the communication or to add/delete parties to a call. In the case of unsuccessful calls, a failure message will be logged. The messages provide details about the calling and called parties, the timing of the call set-up, the duration, the data rate and the quality of service delivered for each segment of the call. Accounting gateway **240** may be duplicated using a redundant computer, with each gateway having dual-mirrored disks. The accounting gateway **240** stores usage records and may then distribute them to linked destinations (for example, billing centers) for processing. Billing centers typically include bill processors that receive accounting information from the accounting gateway **240** and generate appropriate on-line or paper billing to customers. The accounting gateway may be configured to accommodate multiple days worth of accounting records such as the records for one day, two days, three days, four days, a week, or a month. The period in which the data is retained in the accounting gateway may be dependent on business needs, hardware restrictions, and/or the billing cycle. For example, as the end of the billing cycle nears, it may be desirable to shorten the period the accounting gateway holds the data such that calls placed the day the bills are printed are included on the bills. Further, the accounting gateway may both retain and forward data to the billing centers. In this manner, if the equipment at the billing center fails, the accounting gateway **240** may serve as a backup. Similarly, the billing center may act as a backup where the accounting gateway **240** fails.

An Automatic Message Accounting (AMA) format is typically used by circuit-switching systems, packet-switching systems, and other network elements to provide billing usage measurements data (for example, the Bellcore® Automatic Message Accounting Format (BAF)). This data may be utilized either to permit charging the customer for use of network resources or to permit charging other carriers (for example, InterExchange Carrier (IEC) and other Local Exchange Carrier (LEC)) for assistance in placing or changing characteristics of call connections. The normal AMA format and associated processes may be modified to additionally report time stamped entries and data for actual changes in provided bit rate, quality of service, parties to a communication and/or preferred service provider for billable and nonbillable segments of a call; (Internet telephony and usage billing may or may not remain free of charge on a per unit of time basis). The accounting gateway **240** may be configured to convert this information into an Automatic Message Accounting Format (AMA) Format (for example, BAF) records and send these records to the external billing systems using, for example, a TFTP (trivial file transfer protocol). Time-stamp accuracy is typically based on the accuracy of the call manager **218** clock which may be derived from the TOD **212** server. To create appropriate AMA records, the event information produced by the call manager **218** preferably has appropriate information for the telephone service specified such as phone number of the calling party (customer), phone number of the called party(s) (customer), time of day of call or any changes, duration of the call or call segments, if more than one network route, bit rate or quality of service is provided for a communication and use of any discretionary features such as conferencing. Different AMA structures may be generated between On-Net calls (defined as within a network service provider IP network **120**) vs. Off-Net calls (defined as outside of service provider IP network—for example, public switched telephone network) for billing purposes.

The element management gateway (EMG) **238** may provide system management functionality that includes, for example: a) status and performance monitoring for the Operation Administration, Maintenance, and Provisioning center, to gauge the ongoing operation of applications; b) extensive information exchange with a network operations center responsible for ongoing maintenance of one or more applications; c) customizable operations interface to allow the network operations center to view only information required, thus reducing the time spent filtering information; d) centralize distributed application configuration allowing for the centralized configuration of objects residing on a plurality machines; e) proactive network management capabilities to remove the need for constant operator intervention making the day-to-day operations more efficient, and/or f) intelligent display of status information to separate critical issues from low-priority problems allowing the operation center to assign resources to the right problems at the right time.

The multimedia gateway (MG) **230** may be configured to connect to the public switched telephone network **160** and to convert IP based multimedia packets into standard public switched telephone network **160** traffic. The multimedia gateway **230** may include an intelligent trunking interface that communicates with the call manager **218** for automatic trunk sizing and allocation between the IP network **120** and the public switched telephone network **160**. For example, when a system user at the customer premises is using a PC and/or a multimedia phone to communicate with a traditional public switched telephone network **160** user, the communication session involves the transmission/reception of video and audio data. The bandwidth that is required for this type of communication is much greater than that required for a PSTN-to-PSTN voice call or an IP-to-PSTN voice call. The multimedia gateway **230**, as the interface between two systems, may negotiate a larger bandwidth (proportional to data rate) to facilitate the call if the called party is also video enabled. This bandwidth negotiation process typically occurs with a 5ESS or a Local Digital Switch within the public switched telephone network **160**. Typically, a multimedia call, including live video, audio and data, will require greater bandwidth than a voice call supporting a bit rate ranging from 56K to greater than or equal to 1.544 Mbps. However, as the number of users sharing the same link grows, the quality of the transmission deteriorates significantly. The multimedia gateway **230** is able to monitor bandwidth (data rate) usage and actual quality of service and make appropriate adjustments so as to maintain a user selected or default quality of service. Further, it may be desirable for the call manager **218** and the multimedia gateway **230** to communicate between themselves and/or the customer premises equipment **102** to determine whether the user has authorized the additional data rate or a higher quality of service and hence expense of the call. For example, even where a called and/or calling party is video enabled, the user may nonetheless refuse to authorize payment for the increased bandwidth necessary for video.

The Internet gateway (IG) **236** may be connected to the Internet (for example, World Wide Web (www)) and provide a means for IP based data packets to be routed between the IP network **120** and the Internet **180**. Alternatively, IP based

data packets may be routed via the Internet **180**. In exemplary embodiments, the Internet gateway **236** routes data-only packets which share the same priority level with other lower priority, non-real-time traffic consistent with computer data communications presently experienced with the Internet **180**. Consequently, low priority and low latency data traffic on the IP network **120** utilize the Internet gateway **236** to communicate with other IP data networks such as the www. Voice packets may be routed through another network such as the ATM/frame/cell relay network **185**, a private IP network **120**, and/or the public switched telephone network **160** where committed information rates may be more easily obtained.

In exemplary embodiments, the broadband network **1** includes the interfaces which enable connections to existing Operation, Maintenance and Provisioning (OAM&P) **195** systems that support, billing, accounting, provisioning and/or configuration management functions. A Secured Management Data (SMD) Network **190** may be utilized to connect the OAM&P **195** to the accounting gateway **240** and element management gateway **238**. The Secure Management Data network **190** may include a Network Service Division's NSD Net. The Secure Management Data network **190** helps ensure that only secure communication can occur between the IP central station **200** and the OAM&P **195**. This eliminates one potential means of tampering with the billing and provisioning functions in the OAM&P. The billing systems (OSS) **195** may include the Network Operations Center (NOC). The NOC may include a translation server which includes functions for allowing communications and control of diverse networks.

B. Broadband Residential Gateway (BRG)

Referring to FIG. **3**, a preferred embodiment for a broadband residential gateway (BRG) **300** will now be described and explained. The broadband residential gateway **300** may be configured as the interface unit between the remainder of the customer premise equipment **102** devices and the external network. The broadband residential gateway **300** may be connected to the remainder of the broadband network **1** using any suitable mechanism such as a gateway directly into an IP network and/or a cable connection. In the most preferred embodiments, a hybrid fiber-coaxial plant connection is utilized such as hybrid fiber-coaxial (HFC) plant **112**. The hybrid fiber-coaxial plant **112** allows numerous broadband residential gateways **300** to be included on an existing hybrid fiber-coaxial plant **112** without modification to the plant's infrastructure.

The broadband residential gateway **300** may be variously configured to, for example, provide high-speed cable modem capabilities to interconnect one or more associated PCs with each other, with CATV set-top terminals and with the remainder of the broadband network **1**, provide functionality to one or more TVs (using, for example, either an integrated or separate decoder functionality, for example, set top box **350**), one or more telephone connections such as plain old telephone service (POTS) phones and/or digital telephones, cameras, surveillance systems, energy management systems, alarm systems, displays, wireless interfaces, voice processing, remote control interface, display interface, and/or administrative functions. In exemplary embodiments, the broadband residential gateway **300** may a) providing conversion between analog voice and IP voice packets, b) multiplexing/demultiplexing streams of IP voice packets, c) supporting multiplexing/demultiplexing of multiple incoming and outgoing signals including multiple voice, multimedia, data, system administration, and/or TV information signals.

Where the elements of the broadband residential gateway **300** are interconnected, the interconnection may be provided by one or more data buses, for example, a high speed bus (HSB) **360**, processor bus **380**, and/or other interconnection system. The high speed bus **360**, **380** may be configured to provide a flexible conduit for transferring information between the internal hardware, processors and ports. In exemplary embodiments of the broadband residential gateway **300**, the high speed bus **360** may include one or more of the following functional units a) a universal remote control receiver module **365** for transmitting/receiving wireless (for example, infrared, and/or RF) signals (for example, keyboard signals and/or remote control signals) for control of the broadband residential gateway **300** and/or any connected devices, b) a display, display driver, touch screen logic module for driving one or more local and/or remote displays for interfacing with the broadband residential gateway **300** and/or one or more connected devices, c) one or more TV port modules **336** for interconnecting televisions, set-top devices, and/or other audiovisual devices to the broadband residential gateway **300**, d) one or more data port modules **334** for connecting/interconnecting data enabled devices (for example, personal computers, palm top devices, etc.), e) one or more telephony port modules **332** for interconnecting one or more analog and/or digital telephones, f) one or more peripheral port modules **342** for interconnecting one or more peripheral devices such as disk drives, data storage devices, video cassette recorders, DVD devices, audio devices, video devices (for example, camcorders, digital cameras, digital video recorders, stereos, etc.), alarm systems, surveillance systems, energy management systems and the like, g) one or more external/internal intercom modules **344** for interconnecting remote intercom and/or audio security monitoring devices, h) one or more wireless interface modules **345** for interconnecting with various wireless extension devices such as wireless TVs, cordless and/or wireless telephones, wireless LANs, etc., i) one or more voice recognition/voice synthesis modules **355** for generating voice announcements, voice messages, and voice prompts and for recognizing voice generated commands and data, j) set-top box module **350** for performing the functions typically associated with a CATV set-top box locally and/or for communicating with one or more remotely coupled set-top boxes, k) memory **322** (for example, DRAM, RAM, flash, and/or other memory) for storing information and operating data within the broadband residential gateway **300**, l) transceiver **302** for communicating with one or more external broadband networks m) operating program store **330** (for example, ROM, flash, etc.) for storing at least portions of the operating programs for the broadband residential gateway **300** and/or interconnected devices, n) security processor, smart card and/or credit card interface module **340** for providing secure processing functions and/or credit card/smart card transaction functions, and/or o) distributed processing controller **306** which may be a microprocessor and/or one or more interconnected distributed processing modules for controlling the broadband residential gateway **300**. Where the distributed processing controller **306** includes one or more distributed processing modules, the modules may include a telephony processing module (P1) **308**, data processing module (P23) **310**, video processing module (P3) **312**, auxiliary processing module (P4) **314**, IP processing module (P5) **316**, and/or an operations administration maintenance and provisioning processing module (P6) **318** interconnected through one or more busses such as processor bus **380**. The processor bus **380** and/or high speed bus **360** may include any suitable

interconnect bus including intelligent bus configurations incorporating smart buffer logic (not shown in FIG. **3**) to facilitate data transfer between interconnected processors and/or modules. The various modules and/or processing components of the broadband residential gateway **300** may be powered by, for example, a power supply unit (not shown). Each of the individual modules of the broadband residential gateway will now be described in more detail.

According to the present invention, the remote control transceiver **365** or the wireless interface to a portable device **345** may be used for tactile alerting and/or remote alerting for the infirm or handicapped subscriber or remote user. In this manner the user may be alerted by heat, light, sound or vibration to a call and may receive paging messages or other visible messages.

The transceiver **302** may include circuits for converting digital signals to and from RF signals suitable for transmission across a broadband network such as the hybrid fiber-coaxial plant **112**. The transceiver **302** may include one or more input/output ports such as a cable interface (for example, an F connector cable connection) and/or a fiber optic interface connected to a communication media (for example, hybrid fiber-coaxial Plant **112**). The transceiver **302** may be compatible with the DOCSIS 1.0 or later specifications. For signaling purposes, the broadband residential gateway **300** may be compatible with the Media Gateway Control Protocol (MGCP) or other compatible signaling protocol (for example, SIP or H.GCP) to support telephony applications. The transceiver **302** may serve as a modem, a translator and/or a multiplexor/demultiplexor. Data received from the network may be de-multiplexed and placed on the data bus for dispatch to the appropriate peripherals and/or ports. Data from the various ports and peripherals may be multiplexed together for distribution over one or more broadband networks (for example, the hybrid fiber-coaxial (HFC) plant **112**). Where a hybrid fiber-coaxial plant **112** is utilized, the data may be multiplexed onto various frequency bands of the hybrid fiber-coaxial plant **112** in a continuous data stream(s) and/or packetized data stream(s). To facilitate data transfer for various networks, the transceiver **302** may be include one or more registers for data queuing and/or IP tunneling of data packets across the broadband network.

Although the illustration of a display, display drivers, and touch screen logic device **338** suggests that the a display is integral to the broadband residential gateway **300**, alternative embodiments of the broadband residential gateway **300** may provide a user interface via the TV screen, PC screen, video telephone, and/or other display device in addition to, or in lieu of, a display integral to the broadband residential gateway **300**.

The peripheral ports module **342** may include a plurality of ports providing connectivity to external peripherals. Exemplary interfaces include, PCI, Firewire, USB, DB25, etc. Devices which incorporate one or more of these interfaces may utilize the broadband residential gateway **300** to interconnect to the remainder of the broadband network **1**. The exemplary screen portions depicted herein for providing alternate alerting, calling party preferences, terminal configuration, or other features may be displayed on any of these display types and user data entry may be collected via various data input means including touchscreen, keyboard, mouse or voice input.

The external/internal Intercom Module (IM) **344** may include one or more microphones/speakers, voice CODECs, telephony processors, and/or interface ports. The Intercom Module may include voice recognition algorithms capable of recognizing one user from another and setting a bit for each such user indicating their presence or absence from a monitored presence. Where an intercom module **344** is utilized, the built-in circuitry may be configured to detect, for example, unused plain old telephone system telephone(s) and generates a special intercom tone on these unused telephones. In this manner, existing plain old telephone system telephones, digital phones, and/or other devices may serve as an intercom throughout the premises. The controller **306** (for example, such as the PI telephony processor **308**) may function to command the intercom module **344** to determine an appropriate intercom path to select an intercom connection between various locations. In exemplary embodiments, the CODEC may be configured to convert the analog voice signal into IP packets for transmission over one or more data ports **334**, TV ports **336**, display modules **338**, telephony ports **332**, peripheral ports **342**, external/internal intercom ports **344**, wireless interface ports **345**, and/or set-top boxes **350**.

In yet further embodiments, multiple broadband residential gateways **300** may be configured through, for example, IP tunneling, to set-up an intercom connection between multiple remote broadband residential gateways **300**. In this manner, an administrative assistant at the office may be contacted via an intercom connection present at the users home. Thus, one or more individuals disposed at either local and/or remote locations with diverse types of equipment may communicate as an intercom group without the need to communicate via normal dialing procedures.

In addition to intercom services, the intercom module **344** may also configure intercom services for other telephony services (for example, extension transfer, call conferencing, internal caller ID), high speed data services (for example, LAN connections), facsimile transmission/reception, e-mail transmission/reception, video conferencing, and/or CATV/HDTV (Cable Television/High Definition Television) using standard industry protocols such as DOCSIS 1.0 or higher and IP tunneling transmissions. These services are advantageous in that once configured, the user may simulate a work environment in his home.

Though processing may be accomplished by a single processor performing all functions (for example, processing controller **306**), in the preferred embodiment shown in FIG. **3**, the architecture employs a distributed processing controller **306**, and a plurality of processors P1–P6 **308–318**. In the distributed processing architecture, each of the plurality of processors P1–P6 may be configured to have a dedicated function to provide predetermined services or applications. The processors may be coupled together via any suitable mechanism such as the processor bus **380** and/or high speed bus (HSB) **360**. The first processor P1 **308** may include telephony applications such as call set-up, call re-routing, qos or data rate changes, call tear down, and other call functions; the second processor P2 **310** may include management functions such as distribution and coordination of data within the various devices of the broadband residential gateway **300**; the third processor P3 **312** may include video processing functions for configuring control panels, screen displays of attached devices, video conference calls, MPEG decoding functions and other video processing functions: the fourth processor P4 **314** may include an auxiliary processor for off loading special processing functions such as numeric processing; the fifth processor P5 **316** may include interface input/output processing (for example, text to voice and vise versa) and/or Internet protocol (IP) processing functions for configuring data to communicate with the remainder of the broadband network **1** and/or devices attached to the broad-

band residential gateway **300** such as IP telephones or IP enable PCs; and the sixth processor P6 **318** may include processing functions for Operation, Maintenance and Provisioning (OAM&P) processing. Each of the above processors may be an entirely separate processing unit with included RAM, ROM, Flash memory, or may share RAM, ROM, and/or Flash memory. Where shared RAM, ROM, and/or Flash memory is utilized, the memory may be located within the distributed processor controller **306** and/or on the processor bus **380**. Alternatively, the memory may be integrated into the operating program store **330** and/or into memory **322**.

The Distributed Processing Controller **306** with its associated processors (P1–P6) may be coupled to the various elements of the broadband residential gateway **300** so as to enable proper operation of each of the individual components. For example, the distributed processing controller **306** (with any associated processors (P1–P6)) may also coupled to the security processor, smart card/credit card, and interface module **340**, the peripheral port(s) module **342**, and/or the External/Internal Intercom Module **344** for providing control and coordination among devices coupled to the high speed bus **360**.

The display **338** may include, for example, an interactive LED/LCD module positioned in a suitable location such as within or attached to the broadband residential gateway **300**. The display **338** may include an interface to notify, display and receive user inputs and processing status. The display **338** may be configured to display various informational status and data entry screens and screen portions in a hierarchical tree structure according to expected utilization during call set-up and processing. Status screens may be provided for multimedia mail, called party ID, call logs, call set-up, call in progress and associated information, call waiting information, call conferencing, and/or other call related information. The display **338** may provide a display of real time status of the various devices connected to the broadband residential gateway **300** as well as any current connections, calls, and/or data transfers. The display **338** may also include touch screen capabilities that allow information to be input via a plurality of interrelated on-screen prompts, on-screen icons, and/or a keypad (for example, an alphanumeric keyboard). The keypad may be a remote control, numeric keyboard, and/or alphanumeric keyboard.

In one embodiment of the display **338** operation, a user may touch an icon representing a pending voicemail and/or multimedia mail message. The panel may be configured to send an electronic signal to the processing controller **306** and/or an attached processor such as the telephony processor. On receiving the signal, the P1 telephony processor **308** may be configured to generate an IP packet via the transceiver **302** across portions of the broadband network **1** to the multimedia server **222** in IP central station **200**. The multimedia server **222** may authenticate the request by, for example, verifying the caller with call manager **218** which at call-set-up verifies the location of the request and/or the identity of the requesting party, for example, via a user's SIM card or other secure identification means. Where identity of the calling party is being verified, the user may enter an access password by an audio and/or keyboard request in addition to presenting their SIM card. Where an audio request is generated, the user may utilize the external/internal intercom module **344** of the broadband residential gateway **300**, or via a text message entered into the display **338**. The user may then enter the appropriate access code via the onscreen soft keypad, microphone, and/or keyboard. Alternatively, the multimedia message could be stored locally in the broadband residential gateway **300** memory **322** and depending on whether there is a password lock on the broadband residential gateway **300**, the user may not have to enter a password and insert their SIM card to access the message. Where the message is stored locally in the broadband residential gateways **300** memory **322** rather than IP central station, the display **338** simply recalls the message from memory and presents to the user to provide one-touch instant message retrieval.

In embodiments where the broadband residential gateway **300** supports multiple mailboxes, the icons on the LCD/LED may be personalized to show the identity of the owner of the message. Each user may have a different password to ensure privacy of access. An activity log which tracks past and present messages and/or archived multimedia messages may be presented on display **338**. The archive may be stored locally, or at a remote location such as IP central. The archive may be utilized by the user to recall messages which have long since been erased from local storage but may be retrieved from IP central on tape and/or disk storage. This is preferably an optional feature for those users who are less security conscious. The multimedia messages need not be displayed only on display **338**. In alternate embodiments, any of the peripheral devices attached to the broadband residential gateway **300** are capable of receiving the multimedia messages.

The memory **322** may be variously configured to include one or more field-upgradeable card slots for permitting memory expansion. Certain users may wish to enable higher end applications such as near video on demand (for example, pausing of shows via buffering in memory), video conferencing of multiple users, multi-party conferences, call waiting for multiple parties, etc. Accordingly, the use of a broadband residential gateway **300** allows the user to upgrade memory via inserting additional cards. Alternatively, the user may use system memory in IP central and buffer data remotely.

Operating program store **330** may be configured to receive updates. This may be accomplished by having the user replace one or more memory cards or automatically by the IP central station downloading new operating code into one or more residential gateways **300**. In this manner, for example, a plug-in software module required for a multimedia call may be immediately downloaded via BRG **300** to store **330** which serves as a shared program store for multiple PC's or visionphones associated with the BRG **300** in order to enable full multimedia capabilities for the call to one of the PC's or visionphones.

As previously indicated, smart buffer logic (SBL) may be coupled to the telephony port(s) **332**, data port(s) **334**, TV port(s) **336**, peripheral port(s) **342**, and/or the distributed processing controller (DPC) **306**. Where the smart buffer logic is utilized, it may function to buffer IP packets for delivery/receipt over the communication network such as the hybrid fiber-coaxial plant **112**. In addition, the smart buffer logic may include selectable switching and routing algorithms based on services and applications associated with each port. Depending on the destination/source of the IP traffic, the smart buffer logic may multiplex signals from various devices to effect faster information transfer. The smart buffer logic may also allow direct memory access between memory **322** and one or more of the devices and/or ports coupled to the high speed bus **360**.

The telephony port(s) **332** may include various interface circuitry (for example, analog interface, logic and firmware for interfacing with the Plain Old Telephone (POTs) telephones). Also the telephony port(s) **332** may also be

configured to include user interface logic, voice processing logic, voice activity detector logic, voice CODECs, and DTMF (dual tone multi-frequency) tone sensing logic. Echo cancellation and automatic gain control may also be utilized in the telephony port(s) **332** circuitry. In one embodiment, RJ-11 connectors for a plurality of lines (for example, 4) are provided for connection to one or more existing plain old telephone system **110** telephone units. However, the broadband residential gateway **300** may contain any number of telephone connection ports. In this manner, any number of existing user terminals may be connected directly to the broadband residential gateway **300** without modification. Alternatively, the broadband residential gateway can be configured to support, in addition to or as alternative to the plain old telephone system telephone units, ISDN telephones and/or other digital phones (for example, IP telephones) using an appropriate interface.

The data port(s) **334** interface may be variously configured. In one configuration, the data ports include high speed data service connections to, for example, a personal computer (PC) using a LAN connection. For example, the data ports **334** may include an Ethernet 802.3 connection compatible with category **5** unshielded twisted pair (UTP) cable and a RJ-45 connector. The data port(s) **334** may include the necessary interface circuitry for coupling to remote computers.

The TV port(s) **336** may include an interface for conventional television, HDTV and/or CATV services. The TV port(s) **336** typically have one or more F-connectors used for coaxial cable connection to a TV set(s). The TV ports may be configured to connect to a set top box (STB) via the F-connector or directly to a remote television. In embodiments where the settop box is co-located with the television, the data supplied over the TV ports may be either analog and/or digital information. Where the settop box is integrated into and/or comprises the broadband residential gateway **300**, the TV ports may be analog or compatible with HDTV signals.

The broadband residential gateway **300** need not necessarily be limited to home use and is intended to also be utilized in business applications. In some configurations, the broadband residential gateway **300** may serve the same functions and operate as a private branch exchange (PBX). Where greater capacity is desired, one or more broadband residential gateways **300** may be disposed on a PC card and combined in a PC, rackmount, and/or server to create an expandable private branch exchange type system that enables intra-premises calling between telephones connected to various telephone connectors on the broadband residential gateway **300**.

C. Integrated Broadband IP Based Communication System

FIG. **4** shows an exemplary embodiment of the broadband network **1** shown in FIGS. **1–3**, with like components identified with identical numbers. At the extremities of the integrated communications system is the customer premises equipment wit (CPE) **102**, for example, one or more customer premise equipment **102** at each customer location. The customer premise equipment **102** may be configured to include an integrated communication interface device such as the broadband residential gateway **300**. Other customer premise equipment **102** devices such as one or more televisions (TV) **106**, personal computers (PC) **108**, and telephones **110**, etc., may be connected to the broadband residential gateway **300** via various ports as discussed above. The customer premise equipment **102** could include multiple TVs **106**, telephones **110**, and PCs **108** (among other systems and devices not shown) connected to a single and/or multiple broadband residential gateway **300**. Further, in certain embodiments, it may be desirable to divide the broadband residential gateway **300** into more than one physical package. In this manner, certain interface circuitry may be located outside of the home while various processing circuitry may be located near a peripheral device such as in a settop.

Where the broadband residential gateway **300** is coupled to the hybrid fiber-coaxial plant **112** in accordance with a preferred embodiment of the present invention, it may be configured to provide the user with both information data (for example, through an Ethernet interface), telephony access, and bidirectional TV service (for example, HDTV, Digital TV and/or CATV services). In exemplary embodiments, the hybrid fiber-coaxial plant **112** typically includes both coaxial cable and optical fiber networks, though, where desired, the network may include only coaxial cable or optical fiber. The hybrid fiber-coaxial plant **112** may be coupled to a head-end hub (HEH) **115**. The head end hub **115** may provide an interconnection point to gather and/or transform external services (for example, off air and satellite video, public switched telephone network voice, and Internet data) into a format suitable for distribution on the hybrid fiber-coaxial plant **112** for use with the customer premise equipment **102**. The head-end hub **115** may include one or more cable modem termination systems (CMTS) **116** coupled between the hybrid fiber-coaxial plant **112**, a Head-end (HE) **117** and/or an Edge Router (ER) **118**. The edge router **118** may be coupled to the cable modem termination system **116** and to one or more ultra high speed routers (UHR) **121**. One or more ultra high speed routers **121** may be interconnected to each other and/or through a centralized mechanism such as an IP network database to form a high speed network. The high speed packet network **120***n* is one example of the network **120** (for example, IP network) shown in FIG. **1**.

In the embodiment shown in FIG. **4**, the high speed network **120***n* includes the ultra high-speed routers (UHR) **121** configured in a ring configuration. Although this embodiment shows the use of the IP network database (IND) **122**, other configurations are also suitable. Where an IP network database **122** is utilized, it may be desirable to incorporate one or more data sets such as: a IP local number portability database (IP LNP) **122***a* which may be utilized for transferring local DN among service providers when a user changes their service provider; an IP caller/user name database (IP CNAME) **122***b* which may be utilized to provide a database of names relating to IP addresses and/or domain names; an IP line information database (IP LIDB) **122***c* which may provide alternative billing and allow flexibility in determining who pays for a call; and an IP 1-800 Database (IP 8YY) **122***d* which may provide a database of 1-800 numbers relating to the IP network **120***a*. Alternatively, the IP local number portability database may be located at another location, such as at an IP central station (IP Central) **130**. Where desired, a local service management system (LSMS) **150** may be arranged to provide management of the IP local number portability database. Where a local service management system **150** is utilized, a plurality of local service order administration (LSOA) units **152** may be coupled to the local service management system by, for example, a number portability administration center (NPAC) **151**. In this manner, directory numbers may be transported among different service providers. In such a case, a NPAC **151** is generally coupled to the LSMS **150** and uses the LSMS **150** to synchronize the numbering databases and to coordinate the porting process.

As indicated above, the broadband network **1** may include a plurality of interconnected high performance networks **120***n*. Each high performance network **120***n* may include a separate IP central station **200** and/or share a single IP central station. Having distributed IP central stations located throughout the broadband network **1** provides improved performance and quicker response time for an individual user. Although not illustrated, each high performance network **120**, **120***n* may be connected to multiple head-end hubs **115**, each head-end hub **115** may be connected to multiple hybrid fiber-coaxial plants **112**, and each hybrid fiber-coaxial plant **112** may be connected to a plurality of customer premises equipment **102**, each containing one or more broadband residential gateways **300**. The plurality of high performance networks **120***n* may be configured as an interconnected network for routing packetized information from point-to-point in accordance with a desired destination.

The high performance network **120***n* may be configured to provide connectivity for and between a plurality of head-end hubs **115** and/or a plurality of broadband residential gateways **300** and other networks such as the Internet, for example, www **180**, the public switched telephone network (PSTN) **160** and/or various signaling systems such as the SS7 network **170** for end-to-end voice over IP applications. The IP central station **200** may be configured to provide seamless integration and control of the high performance network **120** (for example, an IP based communication system) interface with the public switched telephone networks (PSTN) **160**, signaling system seven (SS7) **170**, and/or the Internet **180** so that packetized data, voice calls, and other signaling information is properly transferred between the broadband residential gateway **300** and the public switched telephone network **160** and Internet **180**. In certain configurations, the hybrid fiber-coaxial **112**, head-end hub **115**, and high performance network **120**, provide a signal conduit for packetized voice and data which may, with the coordination of the IP central station **200**, be provided in the appropriate format between the broadband residential gateway **300**, the public switched telephone network **160**, and/or the www **180**.

D. General Operation of Integrated Communication System

The typical home user is currently required to purchase multiple intelligent data conduits such as multiple set-top boxes, a plurality of conventional, DSL and/or ISDN phones, cable modems, HDTV receivers, satellite receivers, home PC LANs, etc. The integrated communication system of the present invention provides a user friendly versatile communication system that enables low data rate surveillance and energy management functions, voice/data (including video) over IP telephony, information data including digital audio (for example, PC and Internet), television and other high data rate services in a system with one intelligent customer premise equipment **102** interface, the broadband residential gateway **300**. The broadband residential gateway **300** in conjunction with the IP central station **200** provides a flexible communication system that can provide any number of integrated communication service features and functions without requiring the user to become familiar with numerous, diverse types of equipment.

In one exemplary application of the voice over IP operations, the broadband residential gateway **300** digitizes the analog telephony signal using, for example, G.711 μ law coding (64 Kbps Pulse Code Modulation). The digital samples may then be packetized in, for example, the broadband residential gateway **300** into IP packets. The broadband residential gateway **300** may be configured to encapsulate the IP packets into, for example, DOCSIS (Data Over Cable Service Interface Specifications) frames for transmission back to the head-end hub (HEH) **115** over the hybrid fiber-coaxial plant **112**. The hybrid fiber-coaxial plant **112** may then be configured to transport signals for both upstream (to head-end hub **202**) and downstream (to the broadband residential gateway **300** and customer premise equipment **102**) directions. Although the DOCSIS protocol is utilized in this example, any future protocol may also be used for the digitizing and packeting of data. Where the protocol changes, it may be desirable to download new operating code from, for example, IP central station **200** to the individual broadband residential gateways **300**, to update the communication protocols dynamically. When new protocols are adopted, the IP central station may utilize, for example, the system management server **216** to download new protocol data into, for example, the protocol manager in the call manager **218** and the program store **330** in the broadband residential gateway **300**.

Where voice packets are sent over constant bit rate (CBR) channels using unsolicited grants, additional packet data channels may be used to support signaling messages (for example, SGCP, Simple Gateway Control Protocol), high-speed cable modem service and/or other upstream packet data services. The upstream packet data services may be sent using available bit rate (ABR) channels such that the voice channels not impacted by data traffic. All services provided herein should be considered together as variable bit rate services because, during a communication, a user may change their data rate requirements in real time in response to user input. For example, during call set-up and even during a communication, a user may specify or respecify their particular data rate requirements to accomplish a given communication segment.

1. TV Signal Transmission/Reception

The head-end **117** may originate CATV signals for transmission over the distribution network. However, in alternate embodiments, signals may be inserted at other points in the distribution network, such as at various hubs or may arise at remote locations in the network such as IP central. Down stream channels may be utilized to facilitate the transmission of signals from the head-end or other input distribution point to the subscriber premise. Where analog RF signals arrive at the broadband residential gateway **300** of the customer premise equipment **102**, typically, the transceiver circuitry **302** will detect if the signal is addressed to this broadband residential gateway **300**. If so, the transceiver will allow reception of the RF signal. Upon conversion to a digital format, the signal is typically output over the high speed bus (HSB) **360** to one or more associated devices for processing. For example, where the signal is a TV signal, the signal may be output directly to the TV port **336** and/or processed by the settop box **350** prior to outputting to the TV ports **336** and/or display **338**. Where user channel selection is preformed directly in the broadband residential gateway **300**, channel selection may be preformed by remote control transceiver **365** using an external device such as a remote control. As introduced above, the remote control may serve as a tactile alerter or paging device indicating an incoming communication. The remote control receiver may transmit/receive a plurality of individually coded remote control commands from different receivers and process the signals for only one associated device in accordance with the transmitted/received commands. Alternative channel inputs include the display **338** and/or any associated keypad. Authorization to certain channels may be controlled by security processor **340**.

Where a remote settop box is utilized, the box may be coupled directly to the HFC for individual frequency tuning and/or receive a digital feed from the broadband residential gateway **300** after decoding the digital signal. For example, where hybrid fiber-coaxial plant **112** contains fiber connections to locations near the individual homes, it may be desirable to download one or more simultaneous individually requested programming stream(s) and/or digital data stream(s) to the broadband residential gateway **300**. In this manner, the number of channels, movie selections, and/or entertainment options available to the user are unlimited. Cost is minimized since only a single intelligent user interface is used in the home and all televisions, phones, computers, and/or other user interface devices use the same intelligent user interface to the broadband network **1**. In this manner, the broadband network **1** may offer premium television, voice and/or data services to multiple conventional televisions, phones, and PCs without the use of multiple set boxes, modems, and external connections. With a vision phone or a personal computer equipped with a microphone and camera connected to the BRG, video telephony and conferencing is possible. The vision phone camera may also continuously monitor its surrounding area and detect for motion while its microphone may monitor for sounds and report to the broadband residential gateway for voice recognition processing. Thus, the users are provided a single unified interface to satisfy their external data needs.

2. Exemplary Call Flow of an On-Network Call to an Off-Network Call, with the Off-Network Call initiating the Dropping.

FIG. **5** illustrates an exemplary call processing sequence for an on-net call (for example, an IP based call) to an off-net call (for example, a public switched telephone network based call), in which the off-net party initiates the drop call sequence. Of course, the reverse or alternate routing back and forth among alternative networks may be accomplished as well—IP to circuit-switched back to IP and so on. The exemplary call processing sequence operates as follows:

1. Once the broadband residential gateway **300** detects an off hook condition, the broadband residential gateway **300** may generate an off hook signal **508** to the call manager (CM) **218**. The call manager **218** verifies the user's identity by looking for password and SIM card data or other security means, retrieves their user profile, for example, from the card (default qos and other data as well as their identity and preferences) and polls the BRG **300** for the terminal configuration identity that the user is connected through. At the same time, the BRG **300** may advise the call manager **218** of any user entered default or required communication parameters including data rate, quality of service, preferred service provider and the like from the card or a call set-up screen as will be further described herein. The call manager may compare the communication parameters with configuration data and provide an error message to the user if the user may not be able to accomplish a communication as requested. For example, the user may be advised to move to another available terminal connected to the BRG **300**. The off hook signal acts as a dial tone request to the call manager **218**. Alternatively, the broadband residential gateway **300** may collect all Internet address data or dialed digits (collectively, called party address data) before activating the off hook condition. This alternative may be desirable to save resources at the call manager **218** where multiple incoming lines are available to handle any additional calls. Thus, even though one phone is off-hook, the broadband residential gateway **300** determines that other lines are available and does not initiate the off-hook signal until all called party address data have been collected.
2. Where the call is managed by the call manager, the call manager **218** will issue a dial tone message **509** to the requesting broadband residential gateway **300** in order for the broadband residential gateway **300** to generate a dial tone to the associated phone. Where the broadband residential gateway **300** shares management of the call, the broadband residential gateway **300** generates the dial tone in response to the off-hook condition.
3. Where the call is managed by the call manager **218**, the call manager **218** will then enter a state where it polls and collects the dialed digits **510** from the broadband residential gateway **300**. The called party address data including Internet address or dialed digits may then be transferred to the call manager **218** one at a time as they are entered. Alternatively, where the call set-up control process is shared between the broadband residential gateway **300** and the call manager **218**, the broadband residential gateway **300** collects the called party address data and transfers these, together with the off-hook signal to the call manager **218**. This transfer may be facilitated by combining the called party address data with other data into a single or multiple data packets as necessary.
4. On receiving the called party address data, the call manager **218** will determine if translation of called party address data is required and, if so, perform the translation. For example, the call manager may determine whether local number portability has been enabled. Where local number portability has been enabled, the call manager **218** may issue a local number portability (LNP) query **511** to the IP local number portability database **122**. The IP local number portability database **122** may then supply the call manager **218** with a routing number **512** if the called party address data form a valid sequence. Where the called party address data do not form a valid sequence, the call manager **218** will return an error indication to the broadband residential gateway **300**. The error designation may include a tone and/or a more detailed error message for display on, for example, display **338**.
5. Where the call sequence is valid, the call manager **218** may issue a first call proceeding message **513** to the broadband residential gateway **300** indicating that the number is valid and the call is proceeding (for example, a valid on-hook condition).
6. Next, the call manager **218** typically determines whether adequate network resources are available to carry the call by comparing the communication requirements (default requirements or specified requirements) to the network resources and determining least cost routing via least cost route server **255** and alternative network paths in priority order. These are displayed to the user as discussed further herein. The call manager also involves the multimedia server and conference server as necessary. The call manager **218** also polls a BRG associated with the called party to determine if their resources are adequate to complete the communication as requested by retrieving the called party's terminal configuration data. Error messages may be provide to the user if there exists a mismatch between call set-up requirements and called party terminal configuration. In embodiments where the broadband resi-

dential gateway **300** is connected to a hybrid fiber-coaxial plant **112**, the call manager **218** may send an open gate allocation request **514** to the cable modem transmission system **116**. In this event, it is often desirable for the cable modem transmission system **116** to provide a gate allocation acknowledgement **515**. A gate allocation acknowledgement may be utilized to verify that the necessary gate and any alternative gate resources have been allocated.

7. The call manager **218** may send an open connection request **516** to the voice gateway (VG) **232** in order to provision the connection. Once the connection is provisioned, the VG **232** may provide an open connection acknowledgement **517** back to the call manager **218**.

8. For off network connections, it is often necessary to enter a second phase of the connection process involving the appropriate link signaling to establish a call. For example, the call manager **218** may send an ISUP IAM (Initial Address) message **518** containing the directory number (DN) of the called party(s) to the signaling gateway (SG) **234** and conference server **224** as necessary. This process is often utilized to allocate the appropriate voice trunk for communication. The call manager **218** may also send an alerting message **519** to the broadband residential gateway to produce an alerting signal, for example, an audible ringing tone to the user terminal. The signaling gateway **234** may make the appropriate connections when the trunk has been allocated and acknowledge the request with an ISUP A call manager (Address Complete) message **520**.

9. Once the called party has answered the call and connection is established, the signaling gateway **234** may send an ISUP ANM (Answered) message **521** to the call manager **218** indicating that the called party has answered.

10. The call manager **218** may then send a time/date-stamped call start message **522** to the accounting gateway (AG) **240**, indicating the start of the call. The AG **240** may use this information for billing purposes.

11. At this point, the link has been established and a conversation **523** can proceed over the communications path. Note that although signaling system 7 (SS7) signaling is used herein to illustrate the present invention and is a well known signaling protocol utilized in the art of telephony telecommunication, the instant invention is not limited to the use of signaling system 7 (SS7) signaling for call establishment of an off-network call; the use of signaling system 7 (SS7) signaling is merely illustrative. As such, other methods of signaling may be substituted for signaling system 7 (SS7).

    A user may change call parameters in real time by entering new requirements (data rate, quality of service and the like) during a communication. For example, the user may request a greater data rate to play a home video or sequence of digital images to the called party. Steps **1–11** then are repeated to assure the availability of network and called party resources. Any such change may involve a billing change and a date/time stamped call progress change message is sent to the accounting gateway **240** to document the change. Also, periodically during a call, the actual quality of service and data rate may be forwarded by the call manager **218** to the accounting gateway **240**.

12. When the called public switched telephone network user terminates the link, an on hook signal may be sent to the appropriate public switched telephone network switch, such as a 5ESS. The signaling network may then send a call termination message (not shown) to the signaling gateway **234** as notification of the call termination status.

13. The signaling gateway **234** may then generate a release **524** signal to the call manager **218**.

14. Upon receipt of the release **524** signal, the call manager **218** may a) initiate the relinquishment of the provisioned network resources by issuing a close connection **525** message to the voice gateway (VG) **232** and a release complete **526** message to the signaling gateway **234**, b) inform the accounting gateway that the call has been terminated, for billing purposes via, for example, sending a time/date stamped call end **527** message to the accounting gateway **240**.

15. With reference to the close connection **525** message, the voice gateway may respond by issuing a report message **528** to the call manager **218** containing the current status of the call.

16. On receiving the call status report **528**, the call manager **218** may issue a delete connection **529** message to the broadband residential gateway **300**.

17. The broadband residential gateway **300** may then release its resources and sends a status report **530** to the call manager **218**. In addition to the report **530**, the broadband residential gateway **300** may also send an on hook **531** status report to the call manager **218**.

18. The call manager **218** may then inform the broadband residential gateway **300** to report the next off hook condition via message **532**.

19. Where a cable modem transmission system is utilized, the call manager **218** may then issue a release gate **533** message to the cable modem transmission system **116** so that all the modem resources can be relinquished. Once the gate resources have been released, the cable modem transmission system **118** sends a release gate complete **534** message to the call manager **218**. At this point, all resources pertaining to the call have been relinquished.

    Communications may involve call set-up parameters or call change parameters involving a user selected higher data rate and quality of service as discussed above. It is also contemplated to change a preferred long distance carrier in real time in response to user inputs. The call manager **218** may initiate a change in preferred service provider via the accounting gateway **240** which organizes and controls a negotiation between preferred service providers in real time. The service providers, for example, may share their subscriber billing data and collect the electronic signature of the user who authorized the change. For example, AT&T may negotiate a change to MCI during a call and a subscriber may receive bills for the same call whereby a first call segment is billed by one service provider and a second call segment is billed by the other newer preferred service provider.

3. Exemplary Call Flow of an On-Network Call to another On-Network User, Under One Call Manager Control

FIG. **6** illustrates an exemplary call flow of an on-network call to another on-network user, with the call being handled by a single call manager (CM) **218**. In alternate embodiments, different portions of the call set-up sequence may be handled by more than one call manager **218** in the IP network **120**. The exemplary "on-network" call processing sequence operates as follows:

1. Once the broadband residential gateway **300**A detects an off hook condition of, for example, a user terminal, the broadband residential gateway **300**A may generate an off hook signal **607** to the call manager (CM) **218**. The off hook signal may act as a dial tone request to the call manager **218**. As above, the call manager verifies subscriber/user identity and collects call set-up and terminal configuration data.
2. The call manager **218** may then issue a dial tone message **608** to the requesting near-side broadband residential gateway **300**A in order for the broadband residential gateway **300**A to generate a dial tone.
3. The call manager **218** may then enter a state where it polls and collects the called party address data including Internet address or dialed digits **609** from broadband residential gateway **300**A. The dialed digits are transferred to the call manager **218** one at a time. In a similar fashion to the subject matter discussed above, in embodiments where the call setup is shared between the call manager **218** and the broadband residential gateway **300**A, the broadband residential gateway may manage the call set-up and transfer both the off-hook signal and the dialed digits to the call manager **218** within one or more data packets.
4. On receiving the completed dialed digits, the call manager **218** may perform necessary translation as described above, for example, by issuing a local number portability query **610** to the IP local number portability database **122**. The IP local number portability database **122** may then supply the call manager **218** with a routing number **611** if the dialed digits constitute a valid sequence.
5. The call manager **218** may then ensure that adequate network resources and calling party and called party's terminal configuration are available and appropriate to accommodate the call.
6. Where adequate resources are available, the call manager **218** may issue a first setup message **612** to whatever mechanism couples the far side broadband residential gateway **300**, for example, the cable modem transmission system **116**B, to allocate transmission resources on the far side.
7. A call proceeding message and a report on hook condition message **613** may then be sent to the broadband residential gateway **300**A.
8. A gate allocation message **614** may then be sent from the call manager **218** to the cable modem transmission system **116**A, where the broadband residential gateway **300**A is coupled via a cable modem transmission system. In this environment, a gate allocation **614** message may be utilized to set up the relevant modem resources.
9. Where a cable modem transmission system is utilized and receives the setup message **612** from call manager **218**, the cable modem transmission system **116**B may then send a connection request **615** message to the far side broadband residential gateway **300**B.
10. Where a cable modem transmission system **116**B is utilized, the cable modem transmission system may then sends a setup acknowledgement **616** to call manager **218**. Once the resources are allocated by the cable modem transmission system **116**A, the cable modem transmission system may then send a gate allocation acknowledgement message **617** back to the call manager **218**.
11. Once the call manager **218** receives the setup acknowledgement **616** along with the gate allocation acknowledgement message **617**, the far-side broadband residential gateway **300**B may then send a ringing message **618** to the far-side cable modem transmission system **116**B where this connectivity is utilized.
12. In these embodiments, the far-side cable modem transmission system **116**B may then issue an alerting message **619** to the call manager **218**.
13. The call manager **218** may then convey the alert via an alerting message **620** to the broadband residential gateway **300**A, to produce a indicating signal sich as a ringing signal indicating that the call is going through.
14. The cable modem transmission system **116**B may then issue a connect message **622** to the call manager **218** in response to the far-side broadband residential gateway **300**B sending an off hook message **621** to the far-side cable modem transmission system **116**B. At this point, an end-to-end communication path is established and conversation **623** can be facilitated. QoS and data rate monitoring begins and are reported to a user via their display as will be described further herein via call manager **218**.
15. Assuming that the calling party hangs up first, the broadband residential gateway **300**A may initiate an on hook sequence **624** message which may be communicated to the near-side cable modem transmission system **116**A.
16. The cable modem transmission system **116**A may then issue a disconnect message **625** to the call manager (CM) **218**. The call manager **218** may then issue a first delete connection request **626** to the near-side broadband residential gateway **300**A and then a second delete connection request **627** to the far-side broadband residential gateway **300**B.
17. The near-side broadband residential gateway **300**A may respond to the call manager **218** with a report message **628** containing the connection status, as well as an on hook message **630** to verify that the calling party at near-side broadband residential gateway **300**A has terminated the call.
18. The far-side broadband residential gateway **300**B may respond to the call manager **218** with a report message **629** containing the connection status, as well as an on hook message **631** indicating that the called party connection has now been terminated.
19. At this point, the call manager **218** may issue release gate messages **634** and **635** to the near-side cable modem transmission system **218** and far side cable modem transmission system **116**B, respectively, so as to release the modems associated with the call. Once all the resources have releases, the cable modem transmission system **116**A and the cable modem transmission system **116**B may issue gate release complete messages **636** and **637** respectively to the call manager **218**.
20. For simplicity, the accounting processing is not shown. However, the process used in FIG. **5** may be utilized as a billing procedure for on-net calls. Such a process might constitute sending a time/date-stamped call start message from the call manager **218** to an accounting gateway (AG) **240** after the connect message **622** is sent from the far-side cable modem transmission system **116**B to call manager **218**. The call start message, containing initial data rate, preferred service provider and quality of service data, would trigger the start of the billing procedure. Call change messages, as described above, may be initiated by the calling party. Assuming no changes as discussed above, a corre-

sponding date/time stamped call end message providing ending data rate and quality of service data may then be sent from the call manager **218** to the AG **240** after the near-side cable modem transmission system **116**A sends a disconnect message **625** to the call manager **218**. This call end message may trigger the ending of the billing procedure for that call.

Although the IP voice packets for these calls are typically routed over the IP network **120**, the system may, where appropriate, route IP voice packets over the Internet **180**.

II. Alerting IP Broadband Subscribers

A method of alerting IP broadband subscribers and calling parties and of forwarding a communication, forwarding or taking a multimedia message, sending fire alarm and burglar alarm reporting messages or giving a subscriber an alerting reminder message will now be described in some detail with reference to FIGS. **7–10**. FIG. **7** is a collection of screen portions which may comprise screens displayed on displays to users of the present invention such as terminal configuration screens, specialized call alerting screens, call chase me/follow me screens, call set up screens, call progress screens and alternative call routing screens.

FIG. **7**(*a*) is a representative screen portion whereby a user may select and/or the screen portion may display a specialized alerting scheme for audible alerting. In the depicted embodiment, a user is provided with the alternatives of conventional audible ringing or tone differentiation and somewhat non-conventional audible announcements via conveniently placed speakers or visual indicators on displays in the premises where the BRG is located. The audible ring choices **710-1** to **710-6** may comprise a number of alternative distinctive ringing cycles including a sufficient number of alternative choices to accommodate everyone at a premises or sharing a given terminal. While only six unique ring sequences are shown, as many different ring sequences may be provided for as many different users of each of the same terminal or the same broadband gateway. The user may use their mouse to move a cursor or use an automatic voice recognition and response system to select one of the available options for their unique identifying ringing sequence for their terminal or their gateway.

Another alternative indicated as **710**-N relates to the composition of a first announcement message via peripheral or other ports such as "The calling party is XXX; this is a multimedia call; please answer the call at your personal computer." In conventional manner, calling party XXX is indicated by calling telephone number identification; if the call is an Internet call, the calling party may be identified by their calling set-up parameters, terminal configuration data and Internet address.

At the same time as an audible announcement is provided the called party, the caller may be given an audible or visual text message via announcement server **220** or may be delivered the message as an alternative saying "I am currently unavailable, I am at home however, would you prefer to wait as the system tries to reach me at home or would you prefer to leave a multimedia message." Please note that the delivery of the above message to the called party and this message to the calling party assumes 1) that the BRG **300** has identified both the calling party and the called party from the caller's request for a communication 2) the BRG has determined through voice recognition or camera detection or other user locating means that the called party is at home and 3) the BRG has determined from terminal configuration and call set-up data of the caller which terminal resource is appropriate for the multimedia communication requested and 4) appropriately announced the identity of the terminal to the user in real time in response to the receipt of the incoming communication at the IP Central Station **200** and BRG **300**.

FIG. **7**(*b*) is a representative screen portion whereby a user may select and/or the screen portion may display a visible alerting option **721-1**, **721-2**, **721**-n of options **721**. With vision phones, also referred to herein as video phones (typically equipped with camera and display), with personal computers having displays and with televisions via appropriately designed set top terminals and the like, the called or calling party may be alerted via a text message similar to the audible message described above. The most conventional of visible alerting options is a colored light emitting diode option **720-1** with or without visible permanently affixed labels. A personal computer or vision-phone may have a screensaver program that is appropriately selected to output a message **720-2**. A broadcast program or screensaver may be alternatively captioned with a static or scrolling message **720-3**. Other alternative visible alerting options may come to mind of one of ordinary skill in the art.

FIG. **7**(*c*) is a representative screen portion whereby a user may select and/or the screen portion may display a tactile alerting option. A user may carry with them a device that communicates with the broadband residential gateway via wireless interface **345** or may be a remote control transceiver **365**. These terminals may be variously configured to provide additional services such as a universal remote control or remote vision-phone or other multi-featured device. On the other hand, consistent with providing a tactile option which may be felt, for example, as either heat or vibration or both, the device provides a tactile alerting option. Such an option may not only be useful for a user, for example, who is mowing the lawn and cannot hear, but also may be used to advantage by audibly or visibly handicapped persons.

If the subscriber is using their personal computer and talking on their telephone at the same time, the user may be simultaneously alerted of an incoming call by audible means (a barge-in announcement or offer to permit barge-in), visible means (an alert may be provided of the incoming call as a message at the bottom of the computer monitor) or tactile means (the vibration or heat remote unit). These may be provided in selected combination or alternatively or in sequence.

FIG. **8**(*a*) is a representative screen portion whereby a user may select and/or the screen portion may display a chase me schedule. In the depicted embodiment, a user is provided with an opportunity to identify an Address for an IP or telephone communication and details of a schedule for receiving communications at that address. While only the Address is shown in the table, other screen portions may be used as necessary for storage as subscriber profile information on a SIM module, at BRG memory or in memory at the IP Central Station which permit correlation of the address with a location address such as a number and street address, city and state. The user may use their mouse to move the desired position from entry to entry as appropriate and as they complete an entry. Other entries include Time of Day and Days of Week and other data not shown which may likewise be entered. For example, a user may have a telephone number and an IP address for both work and home and a wireless telephone number and a pager number and personal identification code for commuting from the home to office and during travel. Since the BRG may multi-task (for example, include one multi-tasking or multiple parallel processors) and initiate communications in parallel, the BRG may initiate both the work phone and IP addresses

simultaneously. Moreover, the BRG may initiate a first priority address such as a work address simultaneously with another address such as the wireless address and the paging address, especially when the time of day may be a time when the subscriber is likely just arriving at work and may be walking between the car and the office, in the car or at the office. Moreover, the BRG may learn and the data of FIG. **8**(*a*) should be considered default data. For example, the activity log maintained by the processor may be referred to for calculating and learning subscriber habits. These calling patterns and successful and unsuccessful locations of the subscriber may be displayed to the subscriber upon inquiry for the subscriber's feedback. After successfully reaching a subscriber at a location, the BRG may learn, for example, that the subscriber leaves for work at 8:10 AM and not 8:00 AM. The data, which may be considered personal profile data, may be stored on the SIM module that the subscriber carries with them from terminal configuration to terminal configuration.

Not shown in FIG. **8**(*a*) is a follow me set of parameters. As discussed in copending and concurrently filed patent applications of the same inventor, follow-me parameters relate to the entry of temporary information input by a user when the user, for example, is traveling on business. The user may access BRG or IP Central Station memory by dialing a toll-free number or via a web site and enter the telephone number or IP address where they may be reached, for example, at a hotel or restaurant or other travel location. Then, the input information would be restrictive as to date and time of day. For example, the user may only be reached at the Biltmore Hotel between the hours of 12:00 noon and 10:00 PM on a given day. Follow me parameters take precedence over chase me parameters when follow me parameters conflict.

FIG. **8**(*b*) is a representative screen portion whereby a user may select and/or the screen portion may display a personal event calendar for reminder and multimedia messaging purposes. The column titles suggested are merely exemplary and can be otherwise named or ordered in a given screen display. The first column is event, for example, Christmas, December 25, and a user may identify their Christmas card list of persons and addresses under the column Address and an appropriate multimedia Christmas greeting under the column Message that may be scheduled for delivery at a given Time of Day on Christmas day (Date). Other greetings may be predetermined and stored such as for other holidays, Mother's Day and/or other important days such as mom's birthday. Reminder messages to a subscriber may be provided according to the chase me system parameters on a periodic basis to remind the subscriber of Mom's birthday for other purposes, for example, to remember a birthday party or to buy a gift for Mom.

A more typical use of FIG. **8**(*b*) is for event calendar reminders. For example, there may be a meeting with the boss from 9:00–10:00 AM on March 25. The subscriber would want to be reminded via a reminder alert message, perhaps, the day before and the morning of the event before the event. Another event may be a social event such as junior's appearance in a school play on March 24 from 8:00 PM until 11:00 PM. The chase me system may chase the user according to the event calendar reminder and deliver reminders to the user at an automatically calculated or predetermined periodic schedule in advance of the meeting or event. The reminder may be scheduled every work day, for example, as an alerting wake-up call at 7:00 AM for the subscriber, wherever he is.

FIG. **8**(*c*) is one embodiment of a screen or a screen portion for displaying actual and alternative calling party preference data for a given communication to a first called party or user which may be a part of a call set-up screen or a terminal configuration screen. For a second or more called party(s), there may be associated screens and/or screen portions for the other called parties. The user may select for Mom, a high preference level **1** and identify the caller by their telephone number or IP web address, mom@www.com, which according to translation data, may also represent their premises location or, if only a web site or area code area specified the general serving area of area code and web site. Dad may likewise have a high preference level. Friend may have a slightly lower level, **2**. Boss may have a high level of 1. Referring to FIG. **10**, a table indicating the preference levels and exemplary instruction sets, level **1** may represent an indication that the called party user is willing to be located wherever they are and desires to take the call or even allow the caller to barge in on a present call. Level **2** may represent every feature in level one including chase me and follow me except barge-in. Level **3** may represent no chase me, follow me or call forwarding process. Level **4** may represent a communication that is to be permitted the opportunity to take a message only—there is no announcement or alerting of the user/subscriber of the communication. Level **5** is a filtered call that the called party refuses to accept. The calling party will not even be allowed the opportunity to leave a message in level **5**. These levels are merely representative of the calling party preference levels. The call instruction set that attaches to the calling party may be appropriately modified according to time of day, day of week and the like. For example, you may be willing to accept calls from your daughter traveling in Europe at any time of the day, even at night between 8:00 PM and 8:00 AM, but calls from your boss may be limited between the hours of 8:00 AM and 8:00 PM.

FIG. **9** is a collection of screen portions which may comprise screens for terminal configuration. These screens are intended to supplement the data that a broadband residential gateway may automatically collect from the terminal from polling the terminal, for example, the BIOS of a personal computer. All terminal configuration data may be maintained in memory at the gateway and provided to the IP central station **200** when needed. By way of example, terminal number **1** may be a personal computer, a laptop, manufactured by Toshiba having given hardware characteristics and driver capabilities for peripherals. It also has installed software and plug-ins. For example, the personal computer may have already equipped Acrobat, MPEG and JPEG compression, Apple QTVR and other plug-ins or negotiate to receive them. The personal computer finally has bit rate and data handling capabilities as defined by its interface to the network. For example, if the personal computer is linked via an appropriate cable modem to the network, it will have maximum bit rate capability. Other examples shown include a set top terminal/television which may have high definition television display capabilities, an internet telephone and an internet vision-phone station. If a given terminal does not have plug-ins, software and the like necessary to accept a given multi-media call, the gateway may arrange to obtain the missing plug-in in real time as the caller and user are conducting a communication. For example, the plug-in may be related to, by way of example, MPEG compression, decompression, image enhancement, Dolby digital sound, Apple QTVR display and the like. Moreover, the plug-in may be provided on a pay-per-use or per unit of time or permanent installation basis for a fee or for free. When the plug-in is obtained, one or both parties may be alerted to the new capability.

Now an example of remote alerter option set-up will be discussed. The user has left their premises and may be located at a telephone terminal or a web-equipped terminal. The user dials a number such as a toll-free number or inputs a web site address that may be directly associated with their IP central station **200**. The IP central station may provide an appropriate Internet page menu for accessing alerting selection options or the announcement server may, provide a similar audible menu. The screen portions may be similar to those of FIGS. **7–10**. The user may use their subscriber identity module, enter passwords or otherwise identify themselves for validation as a subscriber. The subscriber will then receive an indication that they have been validated. Working through various combinations of screen portion including but not limited to those depicted, the user may select or change 1) a distinctive ringing sequence for an associated terminal of a gateway **300**, 2) change or add to their calling party preference instructions, 3) change terminal configuration data for a terminal associated with gateway **300**, 4) change their chase me or follow me or call forwarding function or data or perform other functions remotely from an internet terminal or telephone terminal.

Now some examples of some predetermined alerting features will be discussed. A first example will be a daughter traveling in Europe, calling home from a telephone. The calling telephone will have an associated country code and city code. The subscriber cannot tell exactly what telephone his daughter will call in from but the subscriber may enter a combination of country codes or country codes in combination with city codes into a calling party preference table such as FIG. **8**(*c*). Moreover, the subscriber may predetermine the daughter's preference level as level **1** and that the daughter may call at any time during the day.

Now the daughter may call at six o'clock and the family may be asleep at 12:00 midnight. The daughter may be informed via announcement server **220** 1) the family is asleep 2) her father is at home 3) the system will attempt to alert her father only 4) would she want to leave a message in stead or wait. The father, sleeping in the bedroom, may be alerted via a tactile alerting means as a first priority or by audible distinctive ringing as a second alternative. A third alternative may be an audible announcement of his daughter's call—that the call is from his daughter and he may take the call at the nearest telephone of his choice.

If the father never answers the telephone, the daughter will be continuously given the option of leaving a message. If the father answers the phone, the father may be given a display of the telephone number or IP address the daughter is calling from and the location of the telephone and any other information provided by the originating international service provider (time-of day, temperature, weather, call set-up and terminal configuration data and the like).

If the father is using the telephone, the daughter will have barge-in privileges to the communication because of her status as level **1** and may be given the opportunity to leave a message or use those privileges.

Another example may be a multimedia business call forwarded from the user's office. The calling party may have been already alerted that the user was not at their office and is willing to take the call at home (the caller may have a priority level **2**, no barge-in, but chase me, follow me privileges). The subscriber is located as being at his swimming pool and carrying his remote control or wireless alerter, for example, by surveillance or camera or voice recognition or other input. The caller may be told that the called party is at home and would the caller like to wait while the called party is alerted to the call and advised of a terminal to accept the communication. Meanwhile, the called party is alerted via distinctive ringing that a call is for them and/or advised via their remote control or wireless alerter if the unit is equipped with a display, or a speaker at the pool or other terminal at the pool that the called party should take the multimedia call at their personal computer in their office.

As introduced above, a subscriber may leave a wake-up call and via the chase me system, be awakened at the appointed hour wherever he may be reached. A subscriber may wish to be alerted when an event is about to happen, for example, one hour before the meeting and the day before the meeting. In the case of preparing for a social event such as Mom's birthday party, the alerting reminder to the subscriber may be combined with automatic transmittal of a personal greeting message to Mom.

Finally a burglar alarm or fire alarm alert will be discussed. Many fire departments are wary about automatic fire reporting from a smoke detector. There may be no fire and the fire truck trip to the premises is wasted and, moreover, there is no permission from the occupant to take remedial measures or to ask questions of. As introduced in our patent application, entitled "Remote Monitoring Through The BRG", U.S. Ser. No. 09/475,666, filed Dec. 30, 1999 a fire may be qualified, for example, as in the kitchen with **150** degree temperature, smoke detection, smoke visibly indicated by camera, by microphones and the like. The fire department will have a high probability that there in fact exists a fire in the kitchen. With chase me and follow me, a conference call may be initiated with the subscriber or another resident to answer questions and gain permission to break in as necessary to put out the fire. The subscriber and the fire department may be simultaneously alerted and via whatever alternative network means possible (phone, internet, wireless and the like) with a high probability of occurrence of a fire. Similarly, a high probability of burglary may be reported by sensing various sensors and reporting the results of the sensors to the police department and the subscriber simultaneously.

With a burglar, there may be an attempt made to disconnect terminals from the BRG. Since the BRG periodically polls for the existence of connected terminals, the loss of a terminal may be reported. Coincident with knowing that the family is not home, the BRG may initiate a simultaneous alerting call to both the subscriber or other resident and the police department and report exactly what it has determined: terminal A disconnected, breakage of glass in basement, movement presently in bedroom and the like.

The following copending U.S. Patent applications, originally filed the same day as the present application, are hereby incorporated by reference:

1. U.S. patent application Ser. No. 09/475,167, entitled "Automatic Port Status Reporting and Selective Call Barge-in For a Broadband Voice Over IP Telephony System and Method" invented by Kung et al.
2. U.S. patent application Ser. No. 09/475,140, entitled "Automatic Cable Phone Service Activation," invented by Kung et al.
3. U.S. patent application Ser. No. 09/475,141, entitled "Broadband Cable Telephony Network Architecture IP ITN Network Architecture Reference Model," invented by Kung et al.
4. U.S. patent application Ser. No. 09/475,142, entitled "IP Conference Call Waiting" invented by Kung et al.
5. U.S. patent application Ser. No. 09/475,143, entitled "Conference Server for Automatic X-Way Call Port Expansion Feature", invented by Kung et al.

6. U.S. patent application Ser. No. 09/475,197, entitled "Wireless Touch Screen Television," invented by Kung et al.
7. U.S. patent application Ser. No. 09/475,195, entitled "Programmable Feature Buttons on a Broadband Residential Gateway," invented by Kung et al.
8. U.S. patent application Ser. No. 09/475,745, entitled "Automatic Call Manager Traffic Gate Feature," invented by Kung et al.
9. U.S. patent application Ser. No. 09/475,201, entitled "Local Number Portability Database for On-net IP Call," invented by Kung et al.
10. U.S. patent application Ser. No. 09/475,747, entitled "Personal IP Follow Me Service," invented by Kung et al.
11. U.S. patent application Ser. No. 09/475,194, entitled "Personal IP Toll-Free Number," invented by Kung et al.
12. U.S. patent application Ser. No. 09/475,196, entitled "User Programmable Port Hunting in an IP Based Customer Premise Equipment," invented by Kung et al.
13. U.S. patent application Ser. No. 09/475,146, entitled "IP Leased Line," invented by Kung et al.
14. U.S. patent application Ser. No. 09/475,160, entitled "Anonymous Call Rejection," invented by Kung et al.
15. U.S. patent application Ser. No. 09/475,161, entitled "Automatic Callback With Distinctive Ringing," invented by Kung et al.
16. U.S. patent application Ser. No. 09/475,162, entitled "IP Multimedia Call Blocking," invented by Kung et al.
17. U.S. patent application Ser. No. 09/475,144, entitled "IP Call Forward Profile," invented by Kung et al.
18. U.S. patent application Ser. No. 09/475,671, entitled "IP Call Forward Follow Me," invented by Kung et al.
19. U.S. patent application Ser. No. 09/475,670, entitled "Enhanced BRG with Display Capabilities," invented by Kung et al.
20. U.S. patent application Ser. No. 09/475,672, entitled "Hand Held Integrated IP Device," invented by Kung et al.
21. U.S. patent application Ser. No. 09/472,292, entitled "Wireless Settop Box," invented by Walker et al.
22. U.S. patent application Ser. No. 09/475,145, entitled "BRG PCMCIA Card Cable Ready for PCs," invented by Kung et al.
23. U.S. patent application Ser. No. 09/476,494, entitled "Broadband Service Access," invented by Kung et al.
24. U.S. patent application Ser. No. 09/475,798, entitled "Method for Providing Broadband Public IP Services," invented by Kung et al.
25. U.S. patent application Ser. No. 09/475,797, entitled "Method For Billing IP Broadband Subscribers," invented by Kung et al.
26. U.S. patent application Ser. No. 09/475,165, entitled "BRG With PBX Capabilities," invented by Kung et al.
27. U.S. patent application Ser. No. 09/475,782, entitled "Chase Me System," invented by Kung et al.
28. U.S. patent application Ser. No. 09/475,673, entitled "Call Hold With Reminder and Information Push," invented by Kung et al.
29. U.S. patent application Ser. No. 09/475,293, entitled "Activity Log For Improved Call Efficiency," invented by Kung et al.
30. U.S. patent application Ser. No. 09/475,779, entitled "Selective Information Admission," invented by Kung et al.
31. U.S. patent application Ser. No. 09/475,166, entitled "User Programmable Fail-proof IP Hotline/Warm-line," invented by Kung et al.
32. U.S. patent application Ser. No. 09/476,493, entitled "Authentication of Broadband IP Telephony Service," invented by Kung et al.
33. U.S. patent application Ser. No. 09/475,667, entitled "Simplified IP Service Control," invented by Kung et al.
34. U.S. patent application Ser. No. 09/475,206, entitled "Personal Control of Address Assignment & Greeting Options for Multiple BRG Ports," invented by Kung et al.
35. U.S. patent application Ser. No. 09/475,661, entitled "Protected IP Telephony Calls Using Encryption (P.I.E -Protected IP Encryption)," invented by Kung et al.
36. U.S. patent application Ser. No. 09/475,294, entitled "Integrated Multimedia Messaging Service," invented by Kung et al.
37. U.S. patent application Ser. No. 09/475,666, entitled "Remote Monitoring Through the BRG," invented by Kung et al.
38. U.S. patent application Ser. No. 09/475,296, entitled "Cable Headend System with Pseudo-Switching Capabilities," invented by Kung et al.
39. U.S. patent application Ser. No. 09/475,287, entitled "A Method for Performing Roaming Across Multiple IP networks," invented by Kung et al.
40. U.S. patent application Ser. No. 09/475,662, entitled "Scalable VoIP network Server For Low Cost PBX," invented by Kung et al.
41. U.S. patent application Ser. No. 09/475,288, entitled "Call Services Transfer," invented by Kung et al.
42. U.S. patent application Ser. No. 09/475,204, entitled "Multiple Call Waiting in a Packetized Communication System," invented by Kung et al.
43. U.S. patent application Ser. No. 09/475,205, entitled "Optimizing Voice Paths in an IP Telephony Network," invented by Kung et al.
44. U.S. patent application Ser. No. 09/475,203, entitled "Call Waiting and Forwarding in a Packetized Communication System," invented by Kung et al.
45. U.S. patent application Ser. No. 09/475,202, entitled "Incoming Call Identification in IP Telephony," invented by Kung et al.
46. U.S. patent application Ser. No. 09/475,290, entitled "Incoming IP Call Remote Party Data," invented by Kung et al.
47. U.S. patent application Ser. No. 09/475,295, entitled "Personal User Network (Closed User Network) PUN, CUN," invented by Kung et al.
48. U.S. patent application Ser. No. 09/475,668, entitled "IP Address Interworking Unit (IAIU) For Automatic IP V4 to V6 Address Translation," invented by Kung et al.
49. U.S. patent application Ser. No. 09/475,669, entitled "Automatic Off-Hook Recovery and Fail-Proof Call Delivery," invented by Kung et al.

Furthermore, all United States or international patents or patent applications, whether published or unpublished and referenced herein should be deemed to be incorporated by reference as to their entire subject matter.

What is claimed is:

1. A method of alerting a broadband user at a first terminal of an incoming multimedia call from a particular calling party comprising the steps of:

receiving input data at a broadband gateway of user preferences of calling parties, calling party locations, and terminal configuration data for a terminal normally utilized by the broadband user;

comparing the user preferences with data describing the incoming multimedia call; and

if the terminal normally utilized by the user is not appropriate for the call, alerting the called user to one of

moving to another terminal or arranging to equip said terminal so that the terminal is appropriate for the call.

2. A method of alerting a broadband user at a first terminal of an incoming multimedia call from a particular calling party comprising the steps of:

receiving input data at a broadband gateway located at a customer premises of user preferences of calling parties, calling party locations, distinctive ringing identity of the user and terminal configuration data for a terminal normally utilized by the user, said input data having been transmitted from a remote web site, the remote web site having an identification module receiver for receiving a subscriber identity module containing terminal configuration data.

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